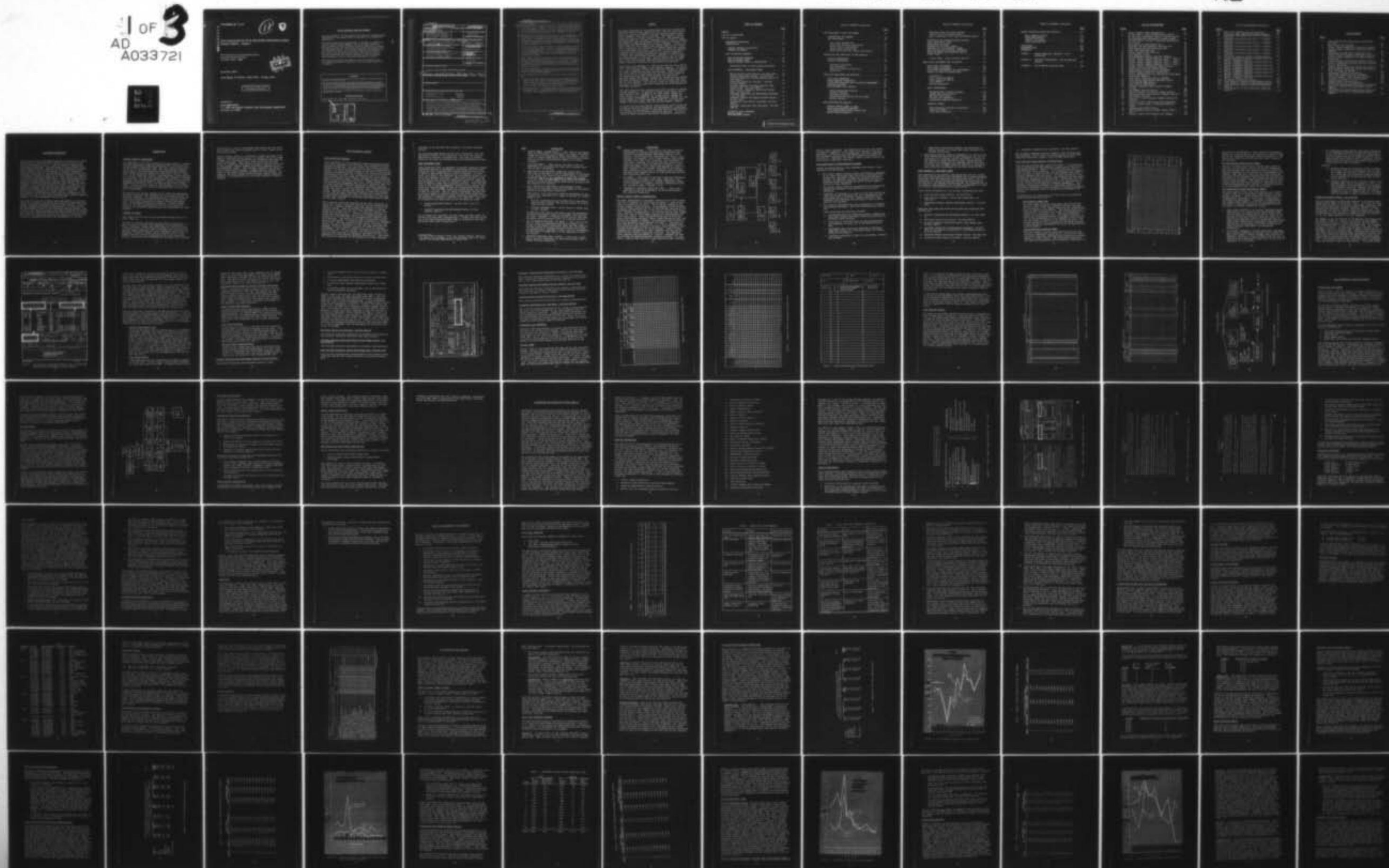
AD-A033 721 RCA GOVERNMENT AND COMMERCIAL SYSTEMS BURLINGTON MASS--ETC F/G 15/5
FIELD EVALUATION OF UH-1H HELICOPTER INSPECTION SYSTEMS. PROJEC--ETC(U)
NOV 76 F W HOHN, B B WIERENGA, J M BARDIS DAAJ02-74-C-0044

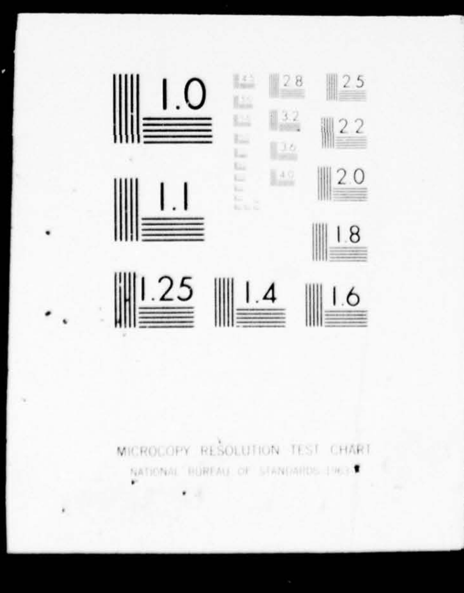
UNCLASSIFIED USAAMRDL-TR-76-27 NL

1 OF 3
AD
A033721



1 OF 3

AD A033721



ADA033721

USAAMRDL-TR-76-27

(12)

B.S.

FIELD EVALUATION OF UH-1H HELICOPTER INSPECTION SYSTEMS
PROJECT INSPECT - PHASE II

RCA Government and Commercial Systems
Automated Systems Division
Burlington, Mass. 01803

November 1976

Final Report for Period 1 May 1974 - 31 May 1976

Approved for public release;
distribution unlimited.

Prepared for

EUSTIS DIRECTORATE
U. S. ARMY AIR MOBILITY RESEARCH AND DEVELOPMENT LABORATORY
Fort Eustis, Va. 23604

EUSTIS DIRECTORATE POSITION STATEMENT

The work performed by the RCA Government and Commercial Systems Automated Systems Division and reported herein is considered to be thorough and comprehensive.

This effort established the effectiveness of the Model for Analysis of Vehicle Inspection Systems (MAVIS) in the structuring of phased inspection schemes for Army helicopters having the capability of reducing maintenance man-hours per flying hour and increasing availability without compromising safety. This scientific approach is an attempt by the Army to match the revolution in aircraft designs and configurations with equally advanced maintenance concepts. The presently used inspection schemes have been virtually unchanged in over two decades, during which great strides in helicopter developments occurred.

This report and the MAVIS Users Manual provide the foundation from which improved maintenance checklists for all other Army aircraft can be produced.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER 19

18 USAAMRDL TR-76-27

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)

6 FIELD EVALUATION OF UH-1H HELICOPTER INSPECTION SYSTEMS. PROJECT INSPECT - PHASE II.

5. TYPE OF REPORT & PERIOD COVERED

Final Report
5/1/74 - 5/31/76

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)

10 Fred W. Hohn, Bruce B. Wierenga, James M. Bardis
Ted E. Kupfrian, Frank E. Starses
~~Frank R. Jelleson~~

8. CONTRACT OR GRANT NUMBER(s)

15 DAAJ02-74-C-0044 New

9. PERFORMING ORGANIZATION NAME AND ADDRESS

RCA Government and Commercial Systems
Automated Systems Division
Burlington, Massachusetts 01803

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

12 248p.

11. CONTROLLING OFFICE NAME AND ADDRESS

Eustis Directorate, U.S. Army Air Mobility
Research & Development Laboratory
Fort Eustis, Virginia 23604

12. REPORT DATE

11 November 1976

13. NUMBER OF PAGES

247

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)

15. SECURITY CLASS. (of this report)

Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

9 Final rept. 1 May 74-31 May 76,

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Phased Inspection System	Helicopter
Field Test	Maintenance
Aviation Data Collection	Inspection

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Department of the Army established Project Inspect was established to analyze aircraft maintenance scheduled inspections and to design an improved schedule inspection scheme that will function effectively in the era of the volunteer Army. ~~RCA studied the~~ various priorities associated with preventive maintenance scheduled inspection systems of Army aircraft were studied, and the resulting restructuring of these systems is based on the analysis of historical data and the modeling results of a developed computer program, MAVIS (Model for Analysis of Vehicle next page

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

409516 dn

Block 20. Continued

Inspection Systems). The output of this effort indicated that proper scheduling of individual component inspections based on failure and failure detection historical data permits an increase in inspection intervals, resulting in increased efficiency and maintenance cost savings. MAVIS development work also indicated that a phased inspection schedule was the most advantageous for Army use.

Project Inspect then developed a phased checklist for the UH-1H Helicopter. The implementation of a scientifically derived phased inspection schedule with opened intervals should result in greater inspection efficiency, reduced maintenance costs, and increased operational readiness. However, proof was needed to establish the validity of MAVIS modeling concepts and the value of projected efficiency improvements and cost savings.

Project Inspect, Phase II, has been employed to furnish the required demonstration under operational conditions. Phase II is a semicontrolled sample data collection program conducted as a field test to determine the acceptance of the UH-1H phased inspection schedule. Goals of the program were to refine and validate the MAVIS Model, refine the UH-1H Phased Inspection Checklist, and release MAVIS to the Army.

Project Inspect, Phase II, has successfully proved that the MAVIS Model can produce inspection schedules and checklists which provide increased inspection efficiency at reduced cost without jeopardizing aircraft safety. In addition, the integration of the MAVIS designed phased inspection checklist into Army operational activity was accomplished with ease and was well received by Fort Campbell user personnel.

The largest problem faced by the field evaluation was accurate data recording. It can be concluded that data collection within the Army must be controlled for it to be useful in maintenance planning.

Several recommendations are provided in this report; among the more important are:

- MAVIS-designed Phased Inspection Schedules should be implemented for other aircraft in the Army inventory and for new aircraft that are scheduled to become a part of the inventory. Once an inspection schedule becomes operational, it should be periodically reexamined and updated using the same design technique it was implemented by (MAVIS Analysis).

- Sample Data Collection (SDC) should be widely used to provide needed maintenance planning data. It is recommended that the semicontrolled method of SDC be employed. Future automation of Aviation SDC should be considered now.

PREFACE

The Field Evaluation of UH-1H Helicopter Inspection Systems was performed under Contract DAAJ02-74-C-0044 with the Eustis Directorate, U.S. Army Air Mobility Research and Development Laboratory (USAAMRDL), Fort Eustis, Virginia. This program is known within the Army as Project Inspect, Phase II. The program was initiated under the technical cognizance of LTC Robert A. Mangum and completed under the guidance of MAJ Roland G. Fontaine of the Reliability and Maintainability Division, USAAMRDL. Project Inspect, Phase II, was a sample data program conducted as a field test to determine the acceptance of a phased inspection schedule by an operational Army group. Goals were to refine and validate a computer model having the capability to produce inspection schedules with increased operational readiness at reduced cost, to refine the UH-1H Phased Inspection Checklist, and to release the computer model to the Army. Project Inspect has met these goals; the field data has indicated positive results, and the phased inspection schedule was enthusiastically accepted.

The primary participating U.S. Army forces were the 101st AVN GP (CBT), 101st ABN DIV (AMBL), Fort Campbell, Kentucky. The men of B, C, and D Companies of the 101st and 158th AVN BNs are thanked for their cooperation and many contributions. Making possible the collection of accurate data was the field office headed by Mr. Frank Jellerson, RCA Service Company and aided by Ms. Patricia Birkby, RCA Service Company; Mr. George Schroer, AVSCOM; CW4 James Gerretson, AVSCOM; and SFC Walter Galloway, HHC 101st AVN GP, Fort Campbell. Mr. Schroer's help was invaluable during the setup of the data collection system and in establishing uniform data recording.

Six Study Advisory Group sessions were held to guide the program through completion. In addition to those listed above, inestimable direction was provided by LTC James Brier, DCSLOG; Mr. Blair Poteate, Jr., USAAMRDL; Mr. George Turton, DARCOM; MAJ Richard Ladd, HQ-MASSTER; Mr. Thomas Greuninger, AVSCOM; Mr. John Bauer, AVSCOM; Mr. Samuel Coffman, AVSCOM; Mr. Jack McCluskie, AVSCOM; CPT John Sheehan, MMC; and SFC Ben Honaker, USAAAVS.

It should also be noted that Mr. Frank Starses served during the program as aircraft reliability and maintainability consultant. Mr. Starses was instrumental in updating the UH-1H R&M data bank and refining the UH-1H Phased Inspection Checklist. He is employed by Kaman Aerospace Corporation, Bloomfield, Connecticut.

TABLE OF CONTENTS

PRECEDING PAGE BLANK-NOT FILMED

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Continued)

LIST OF TABLES

BACKGROUND INFORMATION

The RCA Corporation, with Kaman Aerospace Corporation as a major subcontractor, completed three studies under contract to the Eustis Directorate of the U.S. Army Air Mobility Research and Development Laboratory. The objectives of these studies (Contracts DAAJ02-71-C-0047, DAAJ02-72-C-0052, and DAAJ02-73-C-0018) were to analyze the existing schemes of aircraft maintenance scheduled inspection, to provide specific design approaches for improving the inspection function in future aircraft, to optimize a desirable inspection scheme, and to select inspection schemes for the UH-1H and CH-47C helicopters. This work included the development and application of a computer model (MAVIS-Model for Analysis of Vehicle Inspection Systems) that analyzes the effectiveness of the scheduled inspection schemes. In addition, inspection checklists for these aircraft were generated and validated in accordance with the selected inspection schemes. The latter work is identified as Project Inspect - Phase I. A 100-hour interval and an 800-hour cycle time was recommended as the inspection system for the UH-1H helicopter and a 50-hour interval, 400-hour cycle was recommended for the CH-47C.

The effort included in the above tasks was devoted to the reordering of the various priorities associated with preventive maintenance scheduled inspection systems of Army aircraft. The resulting reordering is based on the analysis of historical data and the modeling results of the developed computer program. The output of this effort indicated that proper scheduling of individual component inspections based on failure and failure detection historical data permits an increase in inspection intervals, resulting in increased efficiency and maintenance cost savings.

INTRODUCTION

PROJECT INSPECT'S OBJECTIVES

The Department of the Army established Project Inspect to analyze aircraft maintenance scheduled inspections and to design an improved schedule inspection scheme that will function effectively in the era of the volunteer Army. RCA found through analysis, field surveys, and discussions with Army operational personnel that current preventive inspections constitute a form of "overkill" to the inspection problem. Overinspection of Army aircraft is believed to not only cause increased labor demands on maintenance personnel, but cause increased spares usage, reduce critical component time between overhauls (TBO's), and cause increases in maintenance-induced failures, including foreign object damage (FOD). Project Inspect, Phase II, was designed to test a phased inspection schedule for the UH-1H helicopter and to verify the above suppositions.

The objectives of Project Inspect are to reduce the maintenance workload on aviation unit personnel and to increase aircraft operational readiness. The implementation of a scientifically derived phased inspection schedule with opened intervals should result in greater inspection efficiency, reduced maintenance costs, and increased operational readiness. Project Inspect Phase II, the field evaluation and test of this inspection schedule, has provided a demonstration and verification of these concepts.

CONTENTS OF REPORT

This report discusses the work accomplished during Project Inspect, Phase II.

The work is generally discussed in the order of occurrence, i.e., data collection planning, data management system development, field orientation, inspection system phase-in, field test monitoring and reporting, field data formatting, data reduction and analysis, MAVIS validation and input refinement, MAVIS Model improvements, checklist update, and the overall results of the phased inspection system implementation and field evaluation. Finally, conclusions and recommendations are given which indicate

the solution to some of the problems encountered and the direction in which the authors believe further Project Inspect activity should proceed.

Project Inspect, Phase II, contributes to Army knowledge in the areas of inspection system design and testing, and in the establishment of a thorough reliability and inspection data bank for the UH-1H aircraft. This report does not present the total wealth of reliability data resident in RCA's computer files, but it does provide computer summary information generated by the data management system. This includes cumulative processing results by group and by company. Summary computer listings are found in the section entitled Data Reduction and Analysis. Appendix A, the final refined UH-1H Helicopter Phased Inspection Checklist, is provided as one of the final products of Phase II activity.

DATA COLLECTION PLANNING

DATA COLLECTION APPROACH

Field evaluation of a new inspection scheme can severely interrupt normal maintenance and interfere with established mission aircraft assignments. For that reason, RCA planned the implementation of the field evaluation on the basis of minimum interference. The field evaluation plan for the UH-1H helicopter designed and delivered as part of Phase I was written with minimum interference with normal Army operations as one of its goals. Army personnel were to continue to function in a data reporting capacity as they do today - within the TAMMS system and AMC 130 report system (TM 38-750 and AR 95-33). Normal aircraft utilization and mission assignments were not to be interfered with (the 25 flight-hour/aircraft/month requirement slightly increased normal utilization). Use of contractor field representatives to gather data and to monitor the test was used to improve data accuracy. However, the Army was required to record two new data entries that utilized a one-digit (recorded on DA Form 2408-13 or its attached continuation sheet DA Form 2404) and "When Discovered" data (recorded on the Monthly Maintenance Report (MMR), DA Form 2407, 2407-1).

RCA's contract called for assisting in the field evaluation of the Project Inspect inspection checklist and the validation and update of a computer software model that analyzes aircraft inspection systems. Data was required to determine if the new checklist is superior to the old. This data was primarily obtained from DA Form 1352-1. Contract representatives were to borrow this form bimonthly, copy it via a copying machine, and forward it to the RCA plant for keypunching and computer evaluation analysis. The second part of RCA's contractural program was more complicated. It required data collection on a component (FSN) level. Data was required for all parts, components, subsystems, systems (identifiable by FSN) when they were adjusted, repaired, replaced, removed, installed or cited for deferred maintenance. This data is currently reported on DA Form 2408-13 and DA Form 2407. For the program, the reporting accuracy utilized on these forms was of particular importance and was to be emphasized by participating commanders and officers. Crew chiefs were especially important to the program due to their thorough

knowledge of the aircraft and closeness to the data reporting process.

The following pages define the new "When Discovered" code used and discuss briefly all DA Forms that were to be collected or monitored by contract representatives. New uses for several blocks of the forms are denoted along with illustrations of each.

WHEN DISCOVERED CODES

"When Discovered Data" is important in aircraft inspection system evaluations because it establishes a historical base for determining how long a component will operate perfectly and how long it takes to deteriorate before it must be replaced. In other words, this data is very important in the decision of when to inspect the component in question. "When Discovered Data" is new to the Army and was first used during Project Inspect, Phase II. Data recording of this data is relatively simple. A single-digit code is added to normal data-recording processes. This code (defined in the following paragraphs) consists of one numeric character that indicates when the need for a maintenance action was discovered. The first two codes also provide another new piece of data for the Army. This is "Abort" information that was used by Project Inspect to calculate mission and flight reliability. These codes were used when a system, subsystem, component or part was repaired or replaced or reported to be defective. Data was to be reported on a daily basis on the following two forms:

1. Monthly Maintenance Report - DA Form 2407, Block 20, Column i.

2. Aircraft Inspection and Maintenance Record, DA Form 2408-13, Block 17.

The following list describes the nine codes used with simple directions for each code's applicability. Further direction on the use of the When Discovered Codes (WDC) is contained in the Data Recording Guide found in Reference 1*.

*Interim Technical Report, Tasks I-V, Project Inspect, Phase II, F.W. Hohn, B.B. Wierenga, et al, RCA technical report No. CR76-588-007, Burlington, Massachusetts, March 1976.

CODE	DESCRIPTION
1	MISSION ABORT - BEFORE FLIGHT - - This code is used when a need for maintenance is discovered by a flight crew before flight and it is necessary to abort the mission. This decision is usually made during flight crew preflight inspection or prestart procedure/after engine start/run-up procedure.
2	IN-FLIGHT ABORT - - This code is used when a need for maintenance is discovered in-flight and it becomes necessary to abort the mission.
3	PREFLIGHT/FLIGHT READINESS INSPECTION (FLIGHT CREW) - - This code is used when a need for maintenance is discovered by the flight crew before flight and/or during a preflight inspection <u>and it is not necessary to abort the mission</u>. It is also used for maintenance needs discovered during the prestart procedure/after engine start/run-up procedure when the mission is not aborted.
4	DAILY INSPECTION (PMD)/AFTER FLIGHT/BETWEEN FLIGHTS - - This code is used when a need for maintenance is discovered during a postflight/daily inspection. This code is also used when a need for maintenance is discovered after completion of a flight or between two flights. Examples are: 1. A pilot, alighting from an aircraft after completing a photo mission, notices that an access panel is missing from the tail section. 2. During a passenger stop, a pilot notices a sudden drop in fuel pressure. In addition, this code is used when a need for maintenance is discovered between flights by personnel other than the air crew. (Example: A mechanic notices an oil leak from an engine while directing a pilot to a parking position.)
5	TEST FLIGHT/MOC/IN-FLIGHT - NO ABORT - - This code is used for all needs for maintenance discovered during a test flight or maintenance operational check that was conducted for the purpose of testing installed aircraft and engine accessories and/or equipment or when a need for maintenance is discovered in flight and it is not necessary to abort the mission.
6	SCHEDULED INSPECTION (PMP, PHASED) - - This code is used when a need for maintenance is discovered during a PMP or Phased Scheduled Inspection.

CODE	DESCRIPTION
7	SPECIAL INSPECTIONS - - This code is used when a need for maintenance is discovered during those inspections published in the Organizational Maintenance Manual (-20). Typical of these inspection conditions are: after a spectrometric oil analysis, after a hard landing, after sudden stoppage, after main rotor overspeed, after excessive engine torque, whenever an aircraft has been subjected to a compressor stall, after a helicopter is flown in a loose grass environment, after engine overtemperature, after engine overspeed, after internal inspection of the engine, after engine post-installation inspection, when the engine accessory drive gearbox has an oil pump drive pad with only one lubricating hole, etc.
8	ALL OTHER - - This code is used when a need for maintenance is discovered on systems, subsystems, components, etc., during acceptance inspection, transfer inspection, inspection of aircraft in storage or during a scheduled activity not covered by Codes 1 through 7 or 9.
9	INTERMEDIATE SCHEDULED INSPECTION (PMI) - - This code is used when a need for maintenance is discovered during a PMI scheduled inspection.

PROJECT INSPECT PHASE II ORGANIZATION

The basic organization of personnel involved in the field evaluation at Fort Campbell is illustrated in Figure 1. Army activity under the command of the 101st. AVN GP CDR was handled by the Project Inspect Project Officer. He designated a senior Sergeant to monitor administrative and day-to-day problems involved in the implementation and field test of the Project Inspect UH-1H checklist. Contract representatives (one from RCA and one from AVSCOM) worked full time at Fort Campbell during the implementation and field trial period. Their responsibilities were to brief and train participating personnel, gather needed evaluation data, and monitor the program's progress. Two battalions were involved in the field evaluation as illustrated in Figure 1. They were the 101st AVN BN and the 158th AVN BN. B, C, and D companies from both battalions were involved in the test, thus providing a full-strength participation of 120 UH-1H aircraft. Three of these companies were designated as "test" companies and used the new phased (Project Inspect) inspection checklist. The remaining three companies were designated as "control" companies and used the existing intermediate/periodic inspection system. All companies, however, were involved in more meticulous data recording

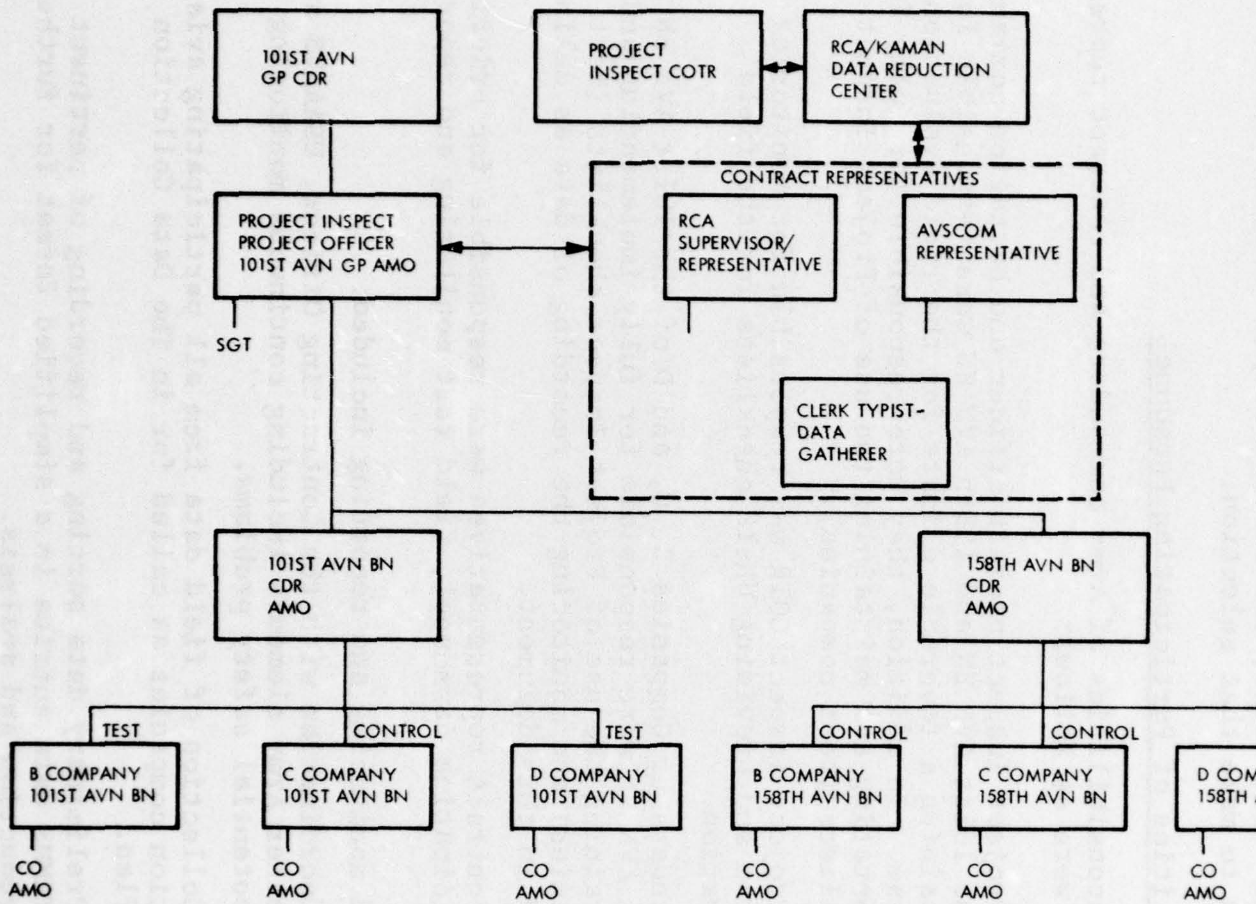


Figure 1. Project Inspect Field Organization.

than is usually required. The selection of the test and control companies was important to the conduct and outcome of the field evaluation. Differences in BN management, personnel capability and performance, and aircraft age and condition can affect the test results. Therefore, the Project Inspect Project Officer was called upon to make that selection.

Responsibilities of Participating Personnel

General responsibilities of Army commanders and contract representatives were as follows:

1. The Project Inspect project officer and battalion commanders of the 101st AVN BN and 158th AVN BN were responsible for maintaining a favorable climate for the field evaluation program. In addition, they were responsible for fully implementating and maintaining the use of Project Inspect checklists (test companies).

2. The Project Inspect COTR was responsible for monitoring the program and providing UH-1H checklists for the field evaluation.

3. Commanders of Companies B, C, and D of the 101st AVN BN and 158th AVN BN were responsible for fully implementing and maintaining the use of Project Inspect checklists (test companies) and monitoring the recording of data as delineated in this document.

4. The contract representatives were responsible for briefing participating personnel, field test monitoring and reporting.

   Field monitoring and reporting included:

   a. Coordination with the Contracting Officer, USAAAVS and other Army elements including continuous monitoring for potential safety problems.

   b. Collection of field data from all participating aviation companies as called for in The Data Collection Plan.

   c. Preliminary data sorting and recording of pertinent TAMMS data entries in a simplified format for further reduction and analysis.

   d. Continuous monitoring of data for correctness, validity, and accuracy.

e. Reporting to appropriate channels any indications of action, inaction, or trends that might jeopardize the validity of the test.

5. Maintenance Officers (AMOs) of Companies B, C, and D of the 101st AVN BN and 158th AVN BN were responsible for the establishment of continuous contact and points of pick-up of the required DA forms with the contract representatives. They were also responsible for assuring correct data entry to records used in TAMMS (TM38-750, AR95-33) as amended by data collection requirements in The Data Collection Plan.

DATA GATHERING - APPLICABLE FORMS

Data gathering by the contract representatives involved copying some forms (representatives were furnished with a copying machine), extracting data from some forms and monitoring others. The establishment of a smooth working relationship for borrowing, extracting data, and reading recorded data was the responsibility of the contract representatives and the AMO's of Companies B, C, and D of both the 101st AVN BN and the 158th AVN BN.

Forms copied periodically by the contract representatives were:

- Daily Aircraft Status Record - DA Form 1352-1
- Army Aircraft Inventory, Status and Flying Time - DA Form 1352
- Maintenance Request (Monthly Maintenance Report) - DA Form 2407.

Forms from which data was extracted and which was monitored periodically are:

- Aircraft Inspection and Maintenance Record - DA Form 2408-13
- Historical Record for Aircraft - DA Form 2408-15
- Aircraft Component Historical Record, Time Change Items, DA Form 2408-16
- Equipment Inspection and Maintenance Worksheet - DA Form 2404 (as utilized for inspections or continuation sheet of DA Form 2408-13)
- Component Removal and Repair/Overhaul Record - DA Form 2410
- Uncorrected Fault Record (Aircraft) - DA Form 2408-14

- Equipment Inspection List (Aircraft) - DA Form 2408-18.

The following paragraphs explain changes to data reporting and data gathering, form by form, with illustrations of those forms which were frequently copied or used for data extraction.

Daily Aircraft Status Record - DA Form 1352-1

This form was borrowed and copied every month. It contains data used in evaluating the new inspection system versus the old (intermediate/periodic). Figure 2 illustrates the form used for daily aircraft status reporting. It is prepared by all organizations required to submit DA Form 1352 and provides daily data on aircraft readiness and utilization. The daily records are consolidated at the end of the month, thus providing the data needed for accurate preparation of DA Form 1352. Instructions for use of both these forms are contained in AR 95-33, Army Aircraft Inventory, Status, and Flying Time (Inventory Management). This regulation establishes standards of operational readiness and prescribes procedures for reporting data on inventory, assignment, status, and operational data on standard and nonstandard Army aircraft.

Explanations of the terms used on DA Form 1352-1 are presented below as extracted from AR 95-33.

Operationally Ready (OR)

The total number of hours during which the aircraft was capable of safe flight and essential equipment necessary for performance of its primary mission(s) was operative and ready to perform the mission(s). The primary mission(s) is the mission(s) for which the aircraft was designed and assigned to the operational unit. Operational readiness status will be measured against the primary mission(s) and will be the determination of the commander of the possessing unit/agency in support of his required missions. The primary mission(s) must correspond to the design missions of the aircraft as contained in FM 101-20 (US Army Aviation Planning Manual).

Reduced Materiel Condition (RMC)

The total number of hours during which the aircraft was limited in operational capability as a result of at least one mission essential subsystem being inoperative for maintenance or supply reasons. RMC reporting is applicable only when the inoperative mission essential subsystem(s) is

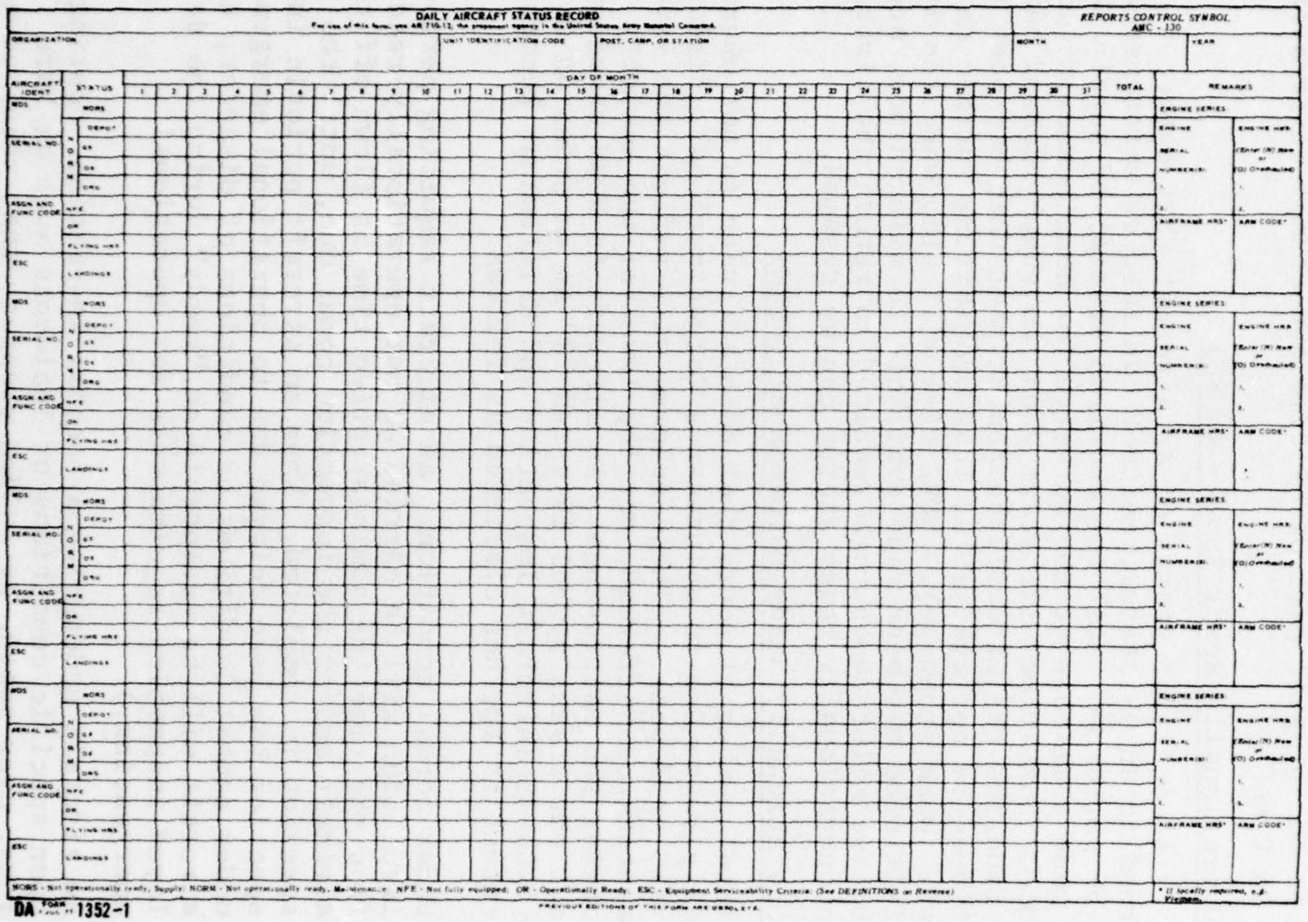


Figure 2. DA Form 1352-1, Daily Aircraft Status Record.

authorized by TDA/TOE/MTOE or other official documentation. Within this criteria RMC will be reported for those aircraft and mission essential subsystems listed in appendix B. RMC time is an integral part of OR time and cannot be greater than OR time.

Not Operationally Ready Supply (NORS)

This is a condition status of an aircraft that cannot be returned to an OR status, neither can further maintenance work be performed until the required item(s) of supply has been made available at the worksite for continuance of maintenance. NORS time will start when the supply demand has been made and the material/component/part that has been requisitioned is not available, thus prohibiting further maintenance (work stoppage). NORS time will stop when the item requisitioned has been made available to maintenance, and productive maintenance work required to return the aircraft to an operationally ready status can be resumed.

Not Operationally Ready Maintenance (NORM)

The total number of hours that each aircraft is not operationally ready due to maintenance (organizational, direct, general, or depot). These columns will reflect the level of maintenance performed, not the level of the activity performing the maintenance. An aircraft is NORM whenever the current status symbol is a red "X" as recorded on DA Form 2408-13 (Aircraft Inspection and Maintenance Record). The intent is further clarified as follows:

a. Under normal conditions, an aircraft requiring periodic inspection will be carried as not operationally ready from the time the administrative time is flown off the aircraft and/or the inspection comes due, until the inspection is completed. When an aircraft periodic inspection has been delayed due to operational emergencies, under combat conditions or conditions of disaster, the aircraft will be acceptable as "ready" during the delayed inspection requirements for operational emergencies.)

b. An aircraft undergoing a special inspection, contingent upon specific conditions or incidents such as hard landings, over speed, or sudden stoppage that requires an immediate inspection to insure further safe use, will be carried as not operationally ready until the aircraft is determined to be airworthy.

c. An operationally ready aircraft that enters inspection or is undergoing maintenance, other than specified in (a) and (b) above, is to be carried in a ready status until an unsafe condition is found or until an item is removed that would create a red "X" condition. The not-ready condition exists until the unsafe condition is corrected or the item is replaced.

Examples:

(1) Removing cowling and inspection plates to inspect an aircraft that is not otherwise a red "X" does not, repeat not, make the aircraft not operationally ready when the cowling and inspection plates can be reinstalled and the aircraft made flyable within one hour.

(2) Removing components such as controls, pumps, rotor assembly parts, wheels for magnetic, zyglo or visual inspection or replacement is not a nonoperationally-ready condition. However, this nonoperational time is to be measured from the time the component or part is removed until it is replaced, then the aircraft is again considered to be ready.

Monthly Maintenance Report - DA Form 2407

Complete maintenance recording was required on the Monthly Maintenance Report (MMR), DA Form 2407, 2407-1. Full block 20 information was required for all systems, subsystems, components, and parts whether they were replaced, adjusted, repaired, checked, removed and reinstalled, removed, installed, tested, etc. The requirements for specific Project Inspect required data entries are the same as those specified in TM38-750, with the exception of the two changes denoted in the next paragraph.

Two changes to the instructions of the MMR were used during Project Inspect, Phase II. Figure 3 illustrates the two changes. The first was a request to leave room on the form for the contract representatives to enter a five-digit code. This pertains to Block 20, item d. The two-digit CB Code is entered on the left-hand side and a vertical line is drawn, leaving space for a five-digit code to be entered later. This space was required because RCA's inspection computer model distinguishes between identical components in the aircraft and breaks down certain large systems with a nomenclature that is different from FSN nomenclature. Consultation with the crew chiefs by contract representatives was required on many of these entries. The second change

MAINTENANCE REQUEST
For use of this form, see TM 38-750; the proponent agency is Office of the Deputy Chief of Staff for Logistics.

*See reverse of file copy for codes and additional data.

PAGE NO. 1 | NO. OF PAGES 2 | REPORTS CONTROL SYMBOL CSGLD-1047 (R1)

SECTION I ☐ WORK REQUEST ☐ MWO ☐ EIR ☐ ORGANIZATION ISSUE PRIORITY DESIGNATOR CODE

CONTROL NUMBER	1a. ORGANIZATION	b. LOCATION	c. UNIT IDEN CODE
664187	2D SQDN 3D AIR CAV	FT CLOSE, TENN 56943	WJBAPO

2. SERIAL NUMBER	3. NOUN NOMENCLATURE	4. LINE NUMBER	5. MODEL	6. FEDERAL STOCK NUMBER
63-6263	APLN UTIL		U-6A	1510-508-0604

7. STRAC	8. UTILIZATION CODE*	9. SELECTED ITEM	10. HOURS	11. MILES	12. ROUNDS	13. STARTS
O	ON	☒ YES ☐ NO	7387			

14. FAILURE DETECTED DURING (Select one use ✓ or X): [A] SCHEDULED MAINTENANCE [C] TEST [E] STORAGE [G] FLIGHT [B] HANDLING [D] NORMAL OPERATION [F] INSPECTION [H] OTHER

15. FIRST INDICATION OF TROUBLE (Select one use ✓ or X): [069] INOPERATIVE [258] OVERHEATING [790] OUT OF ADJUSTMENT [008] NOISY [387] LOW PERFORMANCE [ ] OTHER

16. DESCRIBE DEFICIENCIES OR SYMPTOMS ON THE BASIS OF COMPLETE CHECKOUT AND DIAGNOSTIC PROCEDURE IN EQUIPMENT TM (Do not prescribe repairs)

MONTHLY MAINTENANCE REPORT

END OF MONTH CUMULATIVE FLYING HOURS

AIRCRAFT CUMULATIVE FLYING HOURS AT TIME EACH MAINTENANCE ACTION IS COMPLETED

JULIAN DATE OF EACH MAINTENANCE ACTION RECORDED

CB Code Left Justified; Vertical Line Drawn

SECTION II - WORK ACCOMPLISHED

c. UNIT IDEN CODE

When Discovered Code

TRANS CODE	FAILURE CODE*		d. CB CODE	e. REFERENCE DESIGNATOR	f. MFR. CODE	g. MANHOURS* (Hours & tenths)	h. FEDERAL STOCK NUMBER	i. PART SOURCE CODE	j. QUANTITY	k. PARTS COST
A	020	02		CYL + PISTON ASSY	7360	15.0	1620-00-397-0524	5	1	0308
A	381	03		GASKET	7360	14.5	2310-00-118-2405	5	5	0313
A	381	03		NUT	7360	15.0	5310-00-637-1414	1	5	0313
3		00		PMD	7360	1.4				0315
3		00		PMD	7362	2.0				0316
3		00		PMD	7367	1.6				0317
3		00		PMD	7374	1.5				0320
A	027	03		SLEEVE ASSY	7380	1.0	1560-00-217-5506	3	1	0327
A	020	11		SPRING	7380	1.0	1560-00-307-0042	3	4	0327
B	127	02		BRAKES	7380	2.5	1560-00-103-4563	3	3	0327

l. TOTAL MANHOURS 58.0 | m. TOTAL MANHOURS COST | n. TOTAL PARTS COST

TOTAL OF DA FORMS 2407/2407-1

Work Unit Code to be Entered

21. DELAY (Select one use ✓ or X) | FUNDS | [S] TOOLS | 22. ☐ DATA TRANSCRIBED TO LOG BOOK

INSPECTED BY | 27. ACCEPTED BY H. SMITH | 28. DISPOSITION (Select one use ✓ or X): [A] TO USER [B] TO STOCK [C] SALVAGED [D] EVACUATED [E] CANNIBALIZATION

JULIAN DATE 0305 | JULIAN DATE | JULIAN DATE 0334

SECTION III - EQUIPMENT IMPROVEMENT RECOMMENDATION

29. NORMAL REPLACEMENT (Select one use ✓ or X) [1] YES [2] NO | 30. EIR (Select one use ✓ or X) [E] EMERGENCY [U] URGENT [R] ROUTINE | 31. RECOMMENDATION (Select one use ✓ or X) [A] IMPROVE DESIGN [B] MODIFY [C] REVISE PROCEDURE [D] OTHER (Specify) | 32a. ORGANIZATION/ACTIVITY | b. LOCATION | c. UNIT IDEN CODE | d. SUBMITTED BY

33. FEDERAL STOCK NUMBER | 34. NOUN NOMENCLATURE | 35. OPINION OR REMARKS. DESCRIBE CONDITIONS UNDER WHICH FAILURE OCCURRED. ATTACH PHOTOS OR SKETCHES, IF AVAILABLE

ILLUSTRATES USE OF DA FORM 2407 TO RECORD ORGANIZATIONAL MONTHLY MAINTENANCE ACTIONS

DA FORM 1 JAN 64 2407 CONTROL COPY 3

Figure 3. DA Form 2407, Maintenance Request Used for Reporting Organizational Maintenance Accomplishments.

is the use of Block 20, item i to provide the When Discovered Code. This code was to be entered for component line items in accordance with the definitions presented in the Data Collection Plan. This entry was not required for time change removal and installation actions.

The Work Unit Code identified on Figure 3 is the simplified code that RCA used to store A/C data (refer to Reference 1). As the program implementation unfolded, numerous data recording problems and errors were found. These problems necessitated a change in the original plan for collecting DA Form 2407 data. It was found that line-by-line data review and correction was needed. It was also believed that it would be a problem for crew chiefs and data recording clerks to select the correct WUC code from a pocket manual. Thus, these tasks fell upon the field representatives. They accomplished this by transcribing all needed data onto a newly designed computer form for keypunching. This eliminated data recording errors and keypunch errors at the same time.

Complete maintenance recording on the MMR was required for deferred maintenance, time change removal and installation, components/parts replaced and repaired during scheduled inspections, and work performed by direct support personnel (IDSM) on post. The following paragraphs clarify this requirement; they are a copy of the directions in the Data Collection Plan given to all participating troops during the orientation briefings:

Deferred Maintenance Items

"Deferred maintenance work is entered after it is performed on the MMR. However, the addition of the When Discovered Code complicates this task. This code must be a part of the paperwork used for this type of maintenance to ensure its final correct recording on the MMR. For example, if during a PMD, a deferred maintenance requirement is established, that requirement with a "When Discovered Code" (WDC) of four is recorded on DA Form 2408-13. Then, the deferred work may be listed on DA Form 2408-14 or 2404, and finally after it is performed on the MMR. The same WDC number should be carried forward on all intermediate reports or schedules so when the crew chief fills out the MMR he will know the correct WDC entry."

Time Change Removal

"Time condition units and components are normally reported on DA Form 2410. Project Inspect requires data recording for those same items on the MMR. A complete Block 20 entry

should be made every time a time condition item is changed (Block 20, item i will be blank). For normal time change items reported on the MMR, the failure code 803 should be used. The man-hour entry should be the sum of the removal and installation time (or two MMR lines may be used, one indicating removal, the other installation)."

Components/Parts Worked on During Scheduled Inspections

"Units, components, and parts that are worked on during scheduled inspections (PMD, PMI, PMP, Phased) are not always accorded full Block 20 data recording on the MMR. Project Inspect requires full Block 20 information for these items including action code, failure code, designation, cumulative flying hours, man-hours, FSN, quantity, WDC, and date. TI inspection time should be included in the man-hour entry when applicable."

Direct Support MMR Submittal

"Integrated Direct Support Maintenance (IDSM) actions should be included on the MMR gathered by the contract representatives. If separate MMR's are prepared by Direct Support personnel for organizational level maintenance and this work is not recorded on the unit's MMR, these DS 2407's must also be gathered by the contract representatives."

Abort Data Recording

"Abort data in the form of a WDC code will be recorded on DA Form 2408-13 (referenced paragraph on this form). Abort occurrences usually result in unscheduled maintenance. In addition, the fault entered on DA Form 2408-13 may not indicate the finally found defective component. The component that is found after a troubleshooting process is reported on the MMR. This data entry should include the applicable abort WDC code in Block 20, item i."

Multiple Parts Usage Recording

"Quantity parts usage (same FSN) during scheduled inspections, monthly unscheduled maintenance, etc., will occur. If some of these parts were found under different conditions, i.e., different WDC codes apply, separate Block 20 lines are to be written for each different WDC code."

Aircraft Inspection and Maintenance Record, DA Form 2408-13

The Aircraft Inspection and Maintenance Record is used:

1. To record detected faults and the action taken to correct them.
2. To maintain a continuing record of aircraft flying hours.
3. To record maintenance and servicing performed.
4. To indicate when schedule maintenance inspections become due.
5. To indicate status of the aircraft, and of the installed mission essential equipment.

Project Inspect required that one additional piece of data be added to this form, the When Discovered Code (WDC). This one-digit code provided the abort and when discovered information gathered by the contract representatives. It was recommended that this code be placed in brackets [#] immediately after the detected fault information in Block 17. Figure 4 illustrates the addition of this data for an inoperative engine turbine tachometer. This code was to be included on DA Form 2408-13, Block 17, whenever a system, subsystem, component or part was recorded to be faulty or deficient. Abort information (WDC 1, 2) was to be recorded when an abort occurred even if the flight crew did not know which component or part caused the problem. For example, a vibration in the tail rotor or tail rotor drive train could cause an abort and should be recorded as one. Later on in the trouble-shooting and maintenance recording process, that same code (WDC 1 or 2) must be recorded, with the information on the faulty part found, on the MMR.

Historical Record for Aircraft - DA Form 2408-15

This form was monitored periodically by contract representatives and initially copied for historical data bank purposes.

Aircraft Component Historical Record (Time Change Items) - DA Form 2408-16

This form was monitored periodically by contract representatives.

Army Aircraft Inventory, Status and Flying Time - DA Form 1352

This form was monitored and copied monthly by the contract representatives and was also copied initially to provide historical data.

1. DATE	2. MODEL	3. SERIAL NO.	4. NAME OF CREW CHIEF/MECHANIC	5. STATION	6. PAGE NO.	6a. NO. OF PAGES
26 JUN 71	U-21A	67-18007	G. BOYD	FT. BENNING	1	1

7. STATUS TODAY: AIRCRAFT				ELECTRONIC	ARMAMENT	OTHER
1	—	4	X			
2	X	5				
3	⊗	6				

8. AIRCRAFT TIME		9. NEXT INSPECTION DUE	
TIME TO DATE	478:1	INTMED NO. 1	526:2
TIME TODAY	1:3	PE NO. 5	501:2
TOTAL TIME	479:4	OTHER	:

10.	HOT STARTS: NO. 1 ENGINE	HOT STARTS: NO. 2 ENGINE	LANDINGS b	OTHER c
PREVIOUS		2	41	
TODAY			2	
TOTAL		2	43	

SERVICE NO.	11. FUEL (Gals or Lbs): GRADE	ADDED	TOTAL IN TANKS	12. OIL (Quarts): GRADE	ADDED NO. 1 ENG	TOTAL IN TANKS	ADDED NO. 2 ENG	TOTAL IN TANKS	APU	13. OXYGEN (PSI)	14. ANTI-ICING FLUID (Gals)	15. SERVICED: BY	STATION
1	JP-4		375	23699		9.2		9.2		1500		G. Boyd	FT BENNING
2	JP-4	75	375	23699	1	9.2		9.2		1500		J Brown	FT BELVOIR
3	JP-4	80	375	23699		9.2		9.2		1500		G Boyd	FT BENNING
4													
5													
6													
7													
TOTAL		155			1								

ILLUSTRATES DOWNGRADING OF RED X STATUS SYMBOL

Illustrates Addition of When Discovered Code

16. STATUS	17. FAULTS AND/OR REMARKS	18. ACTION TAKEN	19. SIGNATURE
B	DAILY INSPECTION DUE G. Boyd	COMPLETED 26 JUNE 71	G Boyd
X	#1 ENG TURBINE TACH (N1) INOPERATIVE (I)	STATUS SYMBOL CHANGED TO CIRCLED	W Wilson
	J Spring	RED ⊗, SEE ENTRY BELOW.	
⊗	ACFT CLEARED FOR ONE-TIME FLT FROM FT	ONE-TIME FLT COMPLETED, STATUS	J Spring
	BELVOIR TO FT. BENNING W. Wilson	SYM RETURNED TO RED X, SEE BELOW ENTRY.	

DA FORM 2408-13, 1 DEC 66 REPLACES EDITION OF 1 JAN 64, WHICH WILL BE USED (TM 38-750) AIRCRAFT INSPECTION AND MAINTENANCE RECORD

Figure 4. DA Form 2408-13, Aircraft Inspection and Maintenance Record.

Equipment Inspection and Maintenance Worksheet - DA Form 2404

This form was monitored periodically by contract representatives when utilized for inspection deficiency/corrective action reporting or as a continuation sheet to DA Form 2408-13.

Component Removal and Repair/Overhaul Record - DA Form 2410

This form was monitored periodically by contract representatives. The "man-hours to install" data entry on this form was to be included on the MMR for Project Inspect.

Uncorrected Fault Record (Aircraft) - DA Form 2408-14

This form was monitored periodically by contract representatives.

Equipment Inspection List (Aircraft) - DA Form 2408-18

This form was monitored periodically by contract representatives. The use of this form changed for the test companies using the phased inspection checklist. Former lubrication/servicing, special inspections and checks accomplished during the 25-hour inspection intervals were listed on this form. Thus, the use of the phased inspection did not change the requirement for special inspections and services normally conducted.

HISTORICAL DATA GATHERING

Historical data was gathered by contract representatives during the first five months of the program. Data on all test and control aircraft was required to compile a historical data bank. Three months of back data was sought, including DA Form 1352, DA Forms 2407, 2407-1, and DA Form 2408-15. Arrangements were made by contract representatives with the Project Inspect Project Officer to borrow these forms, copy them and send them to RCA.

SPECIAL FORMS

Special forms for data gathering were not used by Army personnel. However, special forms were used by the field representatives to extract and summarize gathered data and to submit data for computer processing at RCA. Three forms were used by the field representatives to gather raw data and to check if the status, TBO and MMR data was submitted and reviewed each month. Figures 5 through 7 show the forms providing this aircraft serial number related data. Figure 5 is a check form used to affirm that the required data was submitted/received each month. Figure 6 illustrates the

ORGANIZATION

A/C SERIAL NO.	JULY			AUGUST			SEPTEM-BER			OCTOBER			NOVEM-BER			DECEM-BER			REMARKS
	MMR	2407	1352-1	MMR	2407	1352-1	MMR	2407	1352-1	MMR	2407	1352-1	MMR	2407	1352-1	MMR	2407	1352-1	

Figure 5. Data Receipt Accomplishment Form.

D/101	M/R BLADE	T/R BLADE	COLLECTIVE LEVER	ELEVATOR L/H	ELEVATOR R/H	ENGINE	HOT END	42° GEAR BOX	90° GEAR BOX	HORN ASSY ELEVATOR	M/R HUB	T/R HUB	MAST ASSY	QUILL MAIN INPUT	SCISSORS& SLEEVE	SCISSORS LEVER	STABILIZER BAR TUBE	DRIVESHAFT	SWASHPLATE SUPPORT	MAIN TRANSMISSION	DAMPER OR HANGER ASSY	FUEL CONTROL	DATE A/C TIME	PE/ PHASE DUE	PHASE NO.	PMI OR SPEC.	REMARKS
63-8756																											
65-10007																											
67-17425																											
73-21738																											
66-1056																											
66-16024																											
66-16123																											
66-16682																											
66-16715																											
65-10030																											
68-15283																											
68-15360																											
71-20332																											
68-15635																											
65-12874																											
73-22099																											
71-20121																											
71-20160																											
71-20206																											
71-20207																											

Figure 6. Component TBO and Inspection Tracking Form.

ORGANIZATION	DATE	PAGE NO.
MODEL	UNIT IDENT CODE	GROUP NO.

AIRCRAFT SERIAL NO.	STATUS	INSPECTION AND MAINTENANCE FAULTS AND/OR REMARKS INCLUDING ABORTS	ACTION TAKEN AND/OR FSN

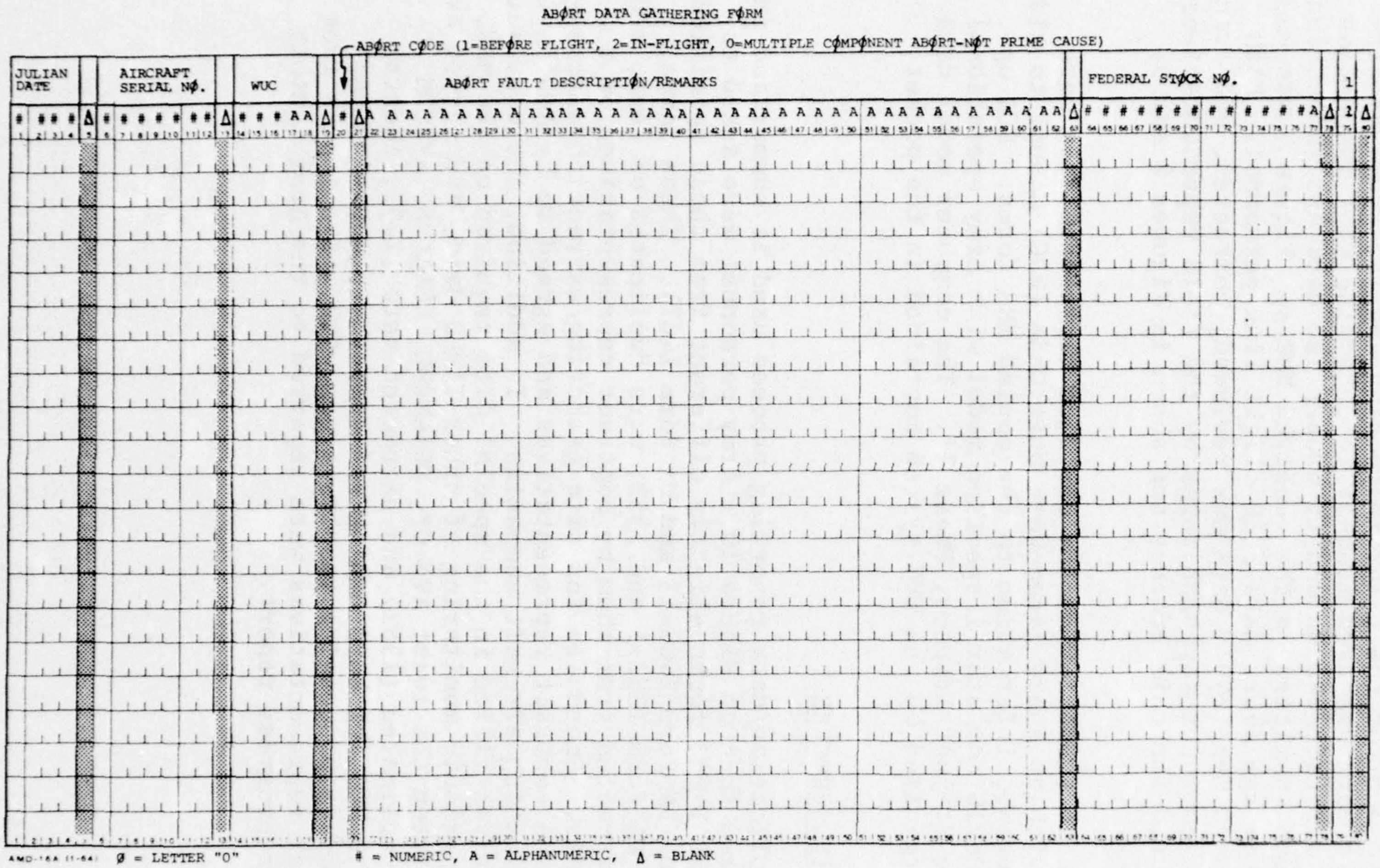
Figure 7. Abort/Inspection Data Extraction Form.

form used to monitor the major inspection and TBO items by aircraft. This form was used monthly to determine what inspection state each aircraft was in and if proper TBO data and inspection data had been submitted on the received MMR's. Figure 7 was used to gather the raw abort data from flight line personnel. Both abort data and MMR (2407) data was reviewed, corrected, and transcribed onto computer keypunch forms by the field representatives. The forms used for this process are shown in Figures 8 and 9, respectively.

In addition to these forms, the contract representatives were furnished with an abbreviated Work Unit Code (WUC) Manual to aid in providing WUC information to the copied MMR forms. RCA updated the MAVIS computer inspection model with Army operational data during Project Inspect, Phase II. The computer model data file was organized by the WUC system contained in the pocket manual.

DATA HANDLING PROCESS

The data collection/data reporting process used is summarized in block diagram form on Figure 10. Army personnel were asked to fill out two TAMMS forms slightly different from those specified in TM38-750 (DA Form 2408-13 and DA Form 2407). These forms, along with DA Form 1352-1 and 1352, were duplicated or kept, and data was extracted from them by contract representatives on a monthly basis. Schedules for data gathering/extraction were suggested by the contract representatives and agreed to by AMO's in all participating aircraft companies. In addition, the contract representatives filled in the special data required on the MMR, performed periodic monitoring of other TAMMS data, and served as liaison between the 101st AVN GP, USAAMRDL, USAAAVS, AVSCOM, DA and RCA. Duplicated (1352) and extracted data (2407, Aborts) were sent to RCA for keypunching and computer processing each month. Summary processing results along with field inputs from the contract representatives were reported to the Army monthly in a letter progress report.



ABØRT DATA GATHERING FØRM

ABØRT CØDE (1=BEFØRE FLIGHT, 2=IN-FLIGHT, 0=MULTIPLE CØMPØNENT ABØRT-NØT PRIME CAUSE)

JULIAN DATE		AIRCRAFT SERIAL NØ.		WUC				ABØRT FAULT DESCRIPTIØN/REMARKS		FEDERAL STØCK NØ.		1	
# ## #	Δ	# # # # # # #	Δ	# # # AA	Δ	#	Δ	A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A A	Δ	# # # # # # # # # # # # # A	Δ	2	Δ

AMD-16A (1-64) Ø = LETTER "O" # = NUMERIC, A = ALPHANUMERIC, Δ = BLANK

Figure 8. Abort Data Gathering Form.

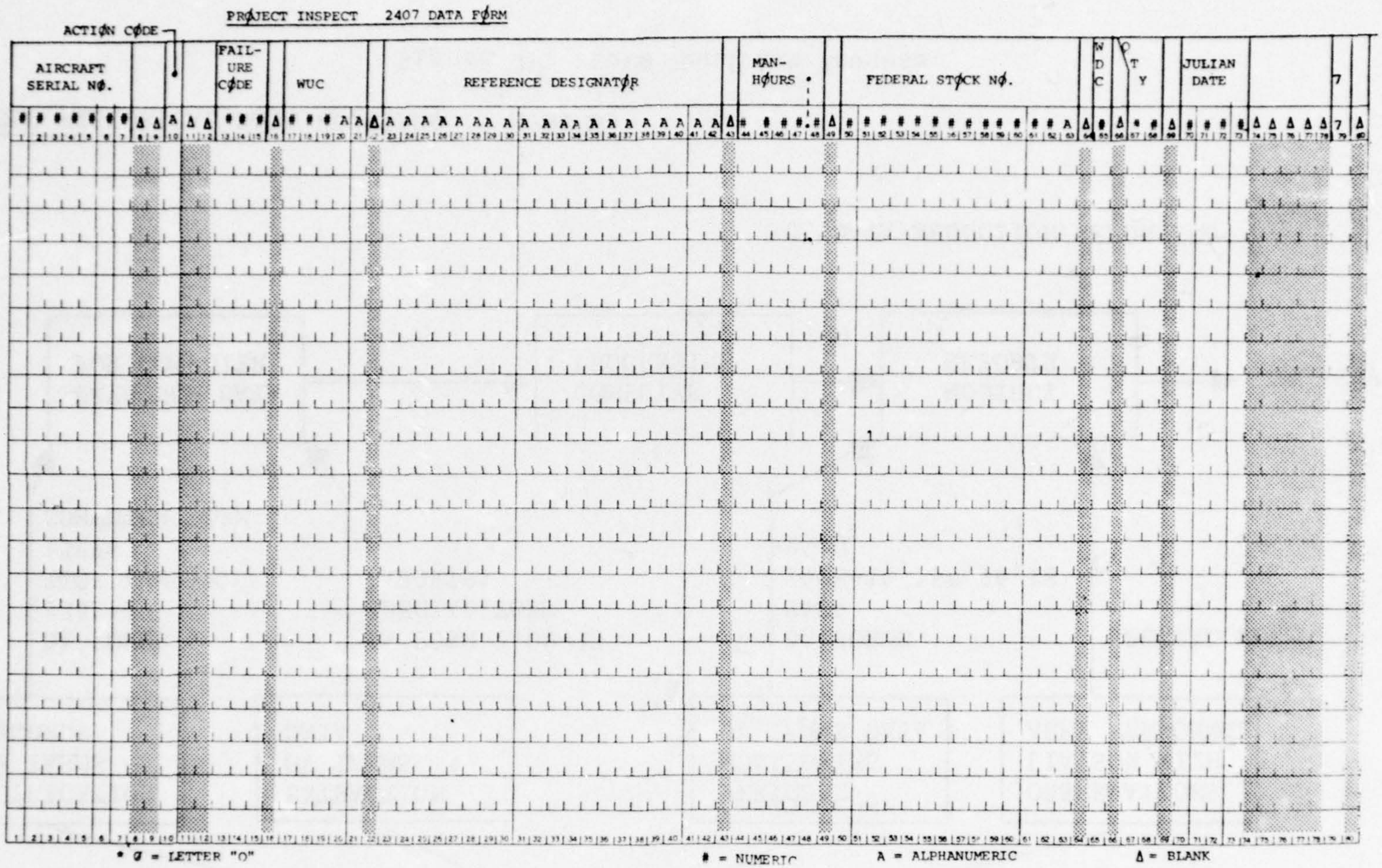
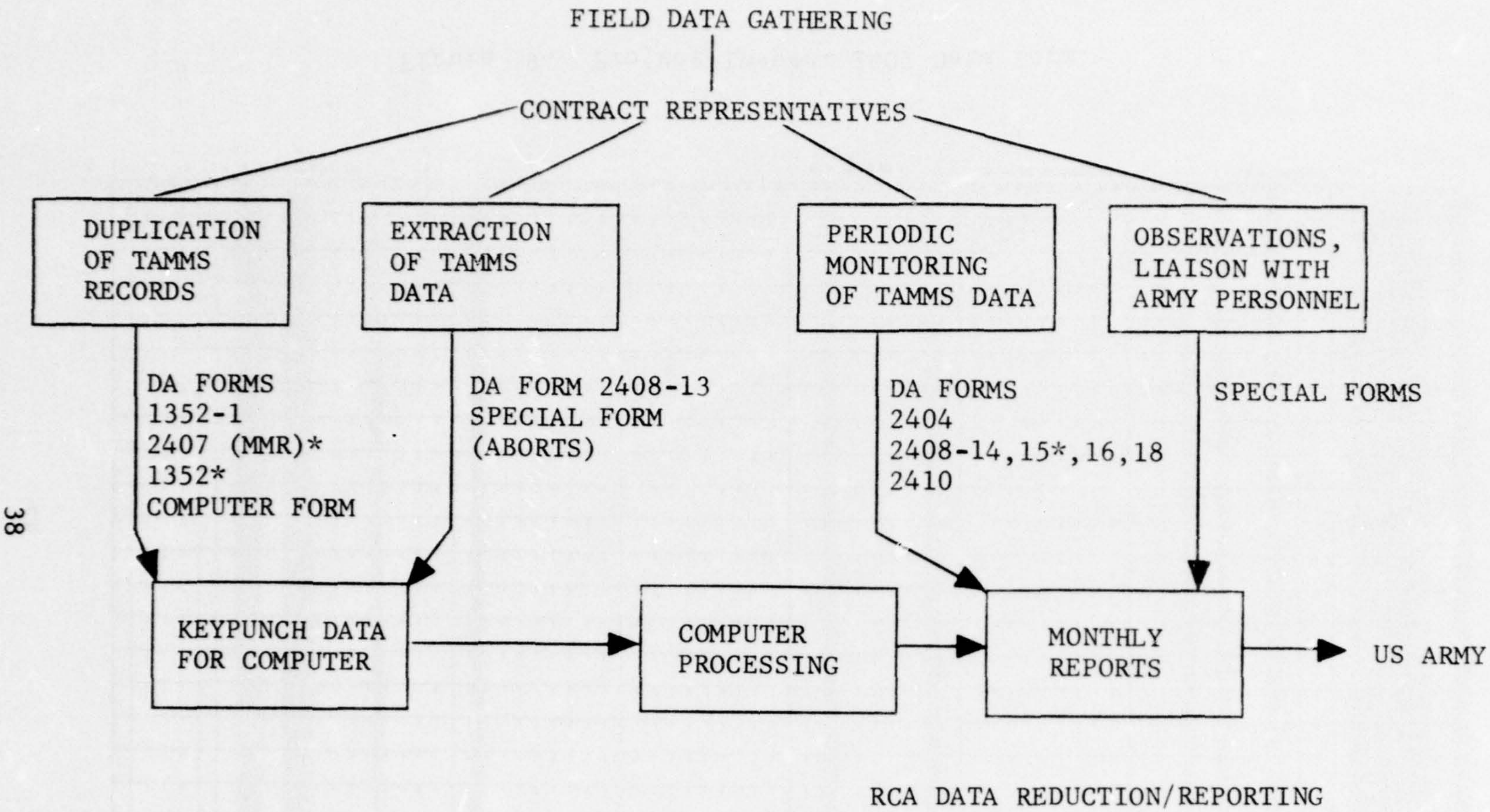


Figure 9. Project Inspect 2407 Data Form.



*OLD HISTORICAL DATA REQUIRED (3 MONTHS)

Figure 10. Data Handling Process.

DATA MANAGEMENT SYSTEM DEVELOPMENT

INTRODUCTION AND SUMMARY

Project Inspect, Phase II, required continuous monitoring of the status and progress of the field test. This provided efficient program control and adequate coordination between the many Army agencies involved. In view of the heavy volume of field data that was processed and analyzed, RCA had to develop a computerized Data Management System (DMS).

The developed software package satisfied the Project Inspect progress/status reporting requirements by generating monthly reports directly applicable to the field evaluation. Computer outputs were generated from a data base that was expanded monthly for the length of the test (15 months). This allowed the cumulative results and the changes in status to be viewed on a monthly basis. Status and results were processed and maintained by aircraft serial number, by aviation company, and by test and control aircraft group.

The Data Management System (DMS) was designed in a series of five computer software jobs:

1. Field Data Preprocessing and Evaluation Criteria Report
2. Cumulative Data Base Update
3. Spares Report
4. Abort Summary Report
5. MAVIS Data Base Update and Critical Component Report.

The software package was written in the PL/I computer language to run on an IBM 360 computer. Programming was performed specifically to handle 15 months of data, the length of the Phase II field test. When all jobs were run, they resulted in a series of 19 computer listings. Reference 1 describes the DMS development effort, the input data used, and each output format and listing. A reference chart is provided on pages 39 and 40 of Reference 1, identifying each job and locating job module descriptions, applicable flow chart sheets, and reproductions of computer formats and listings. Three appendices are used in Reference 1 to provide troop reference data and DMS component lists. Appendix I is the data recording guide used in the field containing DA Form 2407

data recording examples, a description of the When Discovered Codes (WDC), a required data entry table, and action/failure code listings. Appendix II is a large version of the pocket Work Unit Code Manual used by the field representatives. It contains the WUC codes upon which many of the DMS calculations and processing is based. Appendix III contains a listing of Project Inspect critical components and the reference table for converting Work Unit Codes to the MAVIS Model Master Configuration File Codes.

Although the Data Management System produced a great many evaluation criteria results and processed data listings, the maintenance analysist was still required to assess the processed data. This was particularly true when incremental monthly data or changes in a particular parameter were desired.

DMS DEVELOPMENT

The DMS system processed field data by aircraft serial number, by aviation company, and by test and control group. The DMS system was developed in a series of computational modules identified in Figure 11. The modules were organized into a series of five jobs equivalent to the way the computer sequenced through each month's data.

The DMS system essentially processes long lists of aircraft status, flying time and maintenance action data. Early in the development process it was decided to write all DMS software program in PL/I. This language was selected because it is highly suited to the data processing of line data, the prime problem in the data management system. PL/I is modular and is a good tool for writing programs that scan characters, manipulate bits, perform simple arithmetic on binary, bit string and decimal data, and handle data organized in lists linked together by addresses. It is believed that significant savings in coding resulted from the use of PL/I as this compiler generally requires fewer statements to solve a given data processing problem than does COBOL or FORTRAN.

Figure 11 illustrates the major computational modules in the DMS system. They were used to process data on a monthly basis to satisfy the progress status update requirement by providing the capability to generate printed monthly results. The DMS data base expanded as data from the field accumulated. This allowed the cumulative results and changes in status to be viewed on a monthly basis. The following paragraphs provide a description of each computational module.

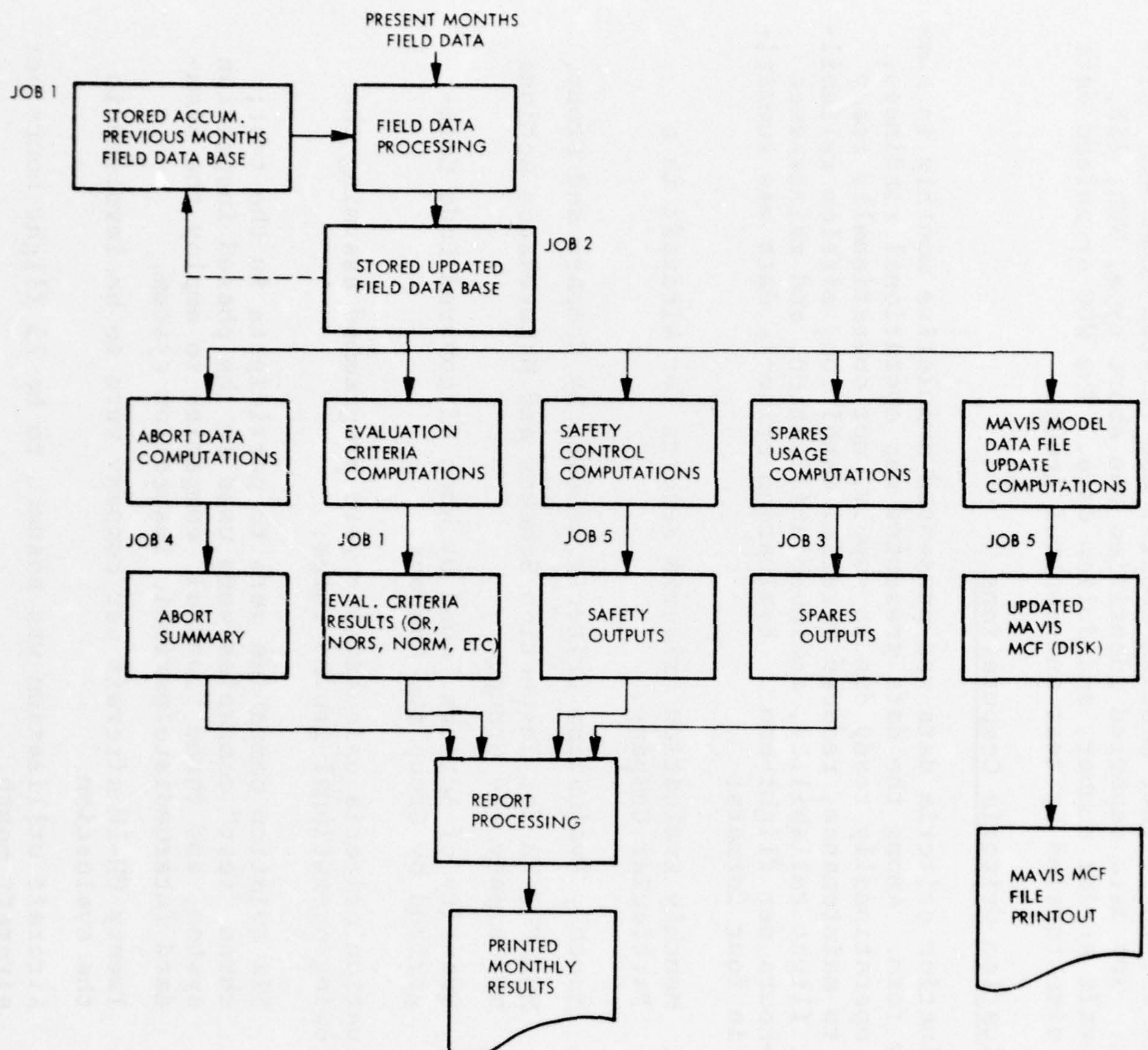


Figure 11. Data Management System Functional Diagram.

Abort Data Computations

An Abort Summary Report was prepared on a cumulative basis each month by Work Unit Code (WUC). WUCs were used to simplify failure reporting on major UH-1H components. The summary report lists all in-flight, mission aborts, and related component failures. The data reported identified the abort type, WUC, FSN, aircraft serial number, and Julian date. The WUC organized data was also totaled by test and control group.

Evaluation Criteria Computations

Evaluation criteria data was presented cumulative monthly in summary form. Among the data presented was operational readiness, not operationally ready due to supply, not operationally ready due to maintenance, reduced materiel condition, mission reliability, flight reliability, achieved utilization, and maintenance man-hours per flight-hour. Evaluation criteria data was summarized in four formats:

1. Monthly Evaluation Criteria Results for Aircraft in a Particular Company.
2. Monthly Evaluation Criteria Results by Company and Group.
3. MMH/FLT-HR for Inspection Schemes and Maintenance Actions by Company and Group.
4. Quantity of Actions Found by When Discovered Code Categorized by Group and Company.

Evaluation criteria calculations were programmed assuming the following operational ground rules:

1. Six aviation companies were to participate in the test; three "test" companies were used in the phased inspection system, and three "control" companies to employ the standard intermediate/periodic inspection system.
2. Twenty UH-1H aircraft per company were to be involved in the evaluation.
3. Aircraft utilization was assumed to be 25 flight hours per aircraft month.

Safety Control Computations

Extraordinary component replacement rates with flight critical subsystems of the test and control groups were flagged by the

safety control program. That program computed replacement rates and compared those rates with "normal" rates derived from historical records. Printouts were generated each month, listing WUC components that exhibited a sample of failures greater than historical statistical limits and thus suggested further investigation for the possibility of potential safety problems.

Spares Usage Computations

The Data Management System also processed components by Federal Stock Number. As the 2407 data was read into the processsing system, lines with Action Codes A, S and U (Replaced, Installed or ORF Exchange) were checked by FSN. A cost table was checked to see if the component involved had a value of $200 or more. If it did, the value was kept with the preprocessed data. Dollar values were not kept if the failure code indicated that it was a cannibalization or a no-defect component (Failure Codes 674, 797-802). Similarly, computer records were kept for time change components. On an aircraft ID basis, the aircraft serial number, Work Unit Code, FSN, nomenclature, quantity replaced, and total dollar cost was accumulated and printed out. A summary printout was furnished indicating (by Company and Test and Control Group) the total quantity replaced, total dollar cost, number of time changes, and total time change dollar cost.

MAVIS Model Data File Update Computations

These computations and processing produced two computer printouts:

1. Project Inspect MAVIS Model Update File
2. Current Project Inspect MAVIS Master Configuration File (MCF).

The update file lists all WUC failures by group. Included on this listing are newly computed values for deterioration start rate, T_{OS}, three most frequent failure codes and percentages, abort probabilities, MMH per failure, WUC quantity per aircraft, major inspection interval, MTBF, total number of failures, number of failures found at each When Discovered Code (WDC) point, number of scheduled and unscheduled failures, scheduled and unscheduled MMH and time change component quantity and MMH if applicable.

The Current MAVIS MCF lists field failure data by MCF code and Test and Control Group rates per 10,000 flight hours. This data was computed from Project Inspect monthly records and includes

scheduled, unscheduled and total repairs; scheduled, unscheduled and total MMH; number of mission and in-flight aborts; and time change replacement, and MMH quantities.

ORIENTATION AND INSPECTION SYSTEM PHASE-IN

Orientation and Inspection System Phase-In for Project Inspect was used to orient and motivate participating personnel at Fort Campbell and to phase-in the test and control aircraft to the inspection and data collection system. To accomplish this, one RCA Service Company representative and one AVSCOM field representative received program orientation via meetings and study of reports, etc., with RCA personnel familiar with the earlier phases of Project Inspect. The field representatives also aided RCA personnel in the preparation of orientation briefings for Army personnel who would participate in the program. Rather than prepare separate briefings for officers, flight crews, maintenance personnel, etc., one complete set of slides was prepared for all Army personnel. (Refer to Reference 1.) This set of slides was also printed along with the Data Collection Plan and furnished to all personnel. Actual presentation of the material was left to the discretion of the RCA Service Company representative. This enabled the material to be tailored to the audience at each briefing and emphasis of key items in the data collection or inspection procedure. In addition, field walk-throughs of the new inspection checklists, group Army meetings, and question-and-answer periods were held. In general, each participating officer or troop received 4 hours of briefing time.

The orientation and system phase-in was aided by the appointment of the Project Inspect Project Officer (101st AVN GP AMO). He gave introductions and scheduled early aircraft phase-in to the new phased inspection schedule. Two general rules were employed for the aircraft phase-in. Starting at the beginning of July, those aircraft with 0-25 flying hours since the last PE were placed directly into the phased system; those aircraft with 26-74 flying hours were flown until 75 flight-hours were reached, then a PE was performed and they were added to the phased system; those aircraft with 75-100 flying hours were subjected to a PE and then added to the phased inspection system. Summer operational exercises prevented the phase-in from being a simple scheduled turnover. Fortunately, the Project Inspect Project Officer was able to work around this constraint and evenly phase-in the participating test aircraft. As of 31 July 1974, 86 percent of the aircraft were phased-in. The second rule followed was a method to evenly distribute the test aircraft among the eight phased

inspection intervals. In general, aircraft were phased into the interval with their same current numeric PE sequence. Thus, if the phased inspection trial was to be terminated a year from the start, the aircraft could easily be placed back into the same PE sequence (i.e., phased inspections are conducted every 100 hours and increase numerically just as PE's do). In addition, special PE's where heavy maintenance is performed could easily be identified.

Phase-in monitoring by the field representative supervisor continued until 21 August, the date that the COTR and the Project Inspect Project Officer established for the beginning of the field evaluation. This activity included advising maintenance and operational personnel on how to fill out the maintenance records required by the Data Collection Plan, gathering of back-data, notification of data recording deviations, additional briefings for new personnel, and resolution of data recording problems such as cannibalization. Field monitoring and assistance by field representatives continued throughout the field evaluation program.

BRIEFING PREPARATION

This task called for the preparation of briefing material to be utilized to orient all Fort Campbell participating personnel. This included commanding and maintenance officers, technical inspectors, pilots, crew chiefs, mechanics, etc. An audience such as this varied both in size and skill and demanded that the briefer (RCA field supervisor) tailor his presentation to his audience by both time and content. To provide this capability a complete set of slides (Reference 1) was prepared providing Project Inspect history, objectives, and the specifics of the field evaluation effort. This gave the briefer the capability of selecting only those slides that were required by a particular audience. Since some of the slides discussed the Data Collection Plan and the required special additions to the data recording process, the plan itself and a complete copy of all slides were given to all participating personnel. A copy of this material is included in Reference 1. The titles of the orientation briefing slides are:

1. Project Inspect Background
2. Analysis of Army Helicopter Inspection Requirements
3. Inspection Requirements Analysis Results
4. MAVIS-A Tool for Designing Advanced Inspection Systems

Although not a part of the formal delivery process, the Data Collection Plan was an important part of the briefing booklet furnished to all troops. The plan contains the words that "go with" many of the vu-graphs and provides a detailed explanation of the data recording process required by Project Inspect. The Data Collection Plan contains sections on background information; Project Inspect; Project Inspect's Objectives; Data Collection Approach; When Discovered Codes; Project Inspect, Phase II, Organization; and Data Gathering, including Applicable Forms, Historical Data Gathering, Special Forms and Data Handling Process. Appendices were also included in that document to reference aircraft components requiring maintenance management and historical data, component work unit codes, and terms/definitions.

In addition to the Project Inspect, Phase II orientation booklet given to all participating troops, a two-card yellow logbook insertion was prepared (Figures 12 through 15), given to all crew chiefs, and added to all log books of the aircraft in the test and control companies. These cards were designed to be a handy reference for personnel recording data on DA Forms 2408-13 and 2407 (Monthly Maintenance Report - Organizational and DS1). The logbook cards summarized Project Inspect data recording changes, list the When Discovered Codes, provide example filled-in DA 2408-13 and 2407 forms with unique Project Inspect requirements, and explain in detail the When Discovered Code definitions. Project Inspect also had the requirement to update the UH-1H computer data bank established during Phase I. This was accomplished by using a Work Unit Code to describe systems, subsystems and components aboard the aircraft. Accordingly, a Work Unit Code Manual had to be designed and furnished to the field representatives for their use in adding this code to the Monthly Maintenance Reports. The Work Unit Code Manual designed is presented in Appendix II of Reference 1.

PHASE-IN MONITORING

Field representatives were responsible for briefing participating Army personnel, assisting personnel in data recording where necessary, and monitoring initial testing activity. Activities of a field test monitoring nature that were also applicable to the phase-in monitoring task were:

1. Continuous monitoring for potential safety problems.
2. Monitoring of the testing and reporting of problems in inspection system implementation and data collection which may jeopardize testing validity to the Project Inspect Project Office and to the RCA program manager.

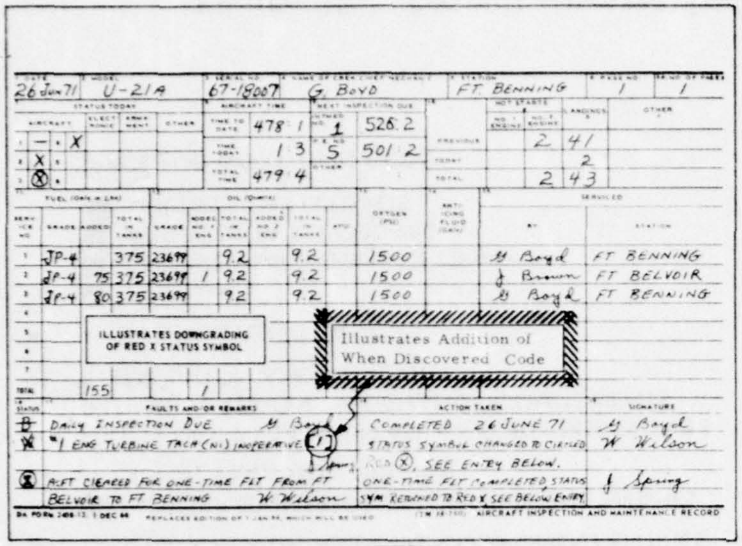
PROJECT INSPECT DATA RECORDING CHANGES

- DA FORM 2408-13 AIRCRAFT INSPECTION AND MAINTENANCE RECORD
  - WHEN DISCOVERED CODE ENTRY [ ]
- DA FORM 2407 MONTHLY MAINTENANCE REPORT
  - FULL BLOCK 20 DATA ON ALL COMPONENT ENTRIES
    - ■ SCHEDULED INSPECTION COMPONENT ENTRIES (PMD, PMI, PMP, PHASED)
  - FULL BLOCK 20 DATA ON ALL DA FORM 2410 ENTRIES (MAN-HR DATA ON TIME CHANGE COMPONENTS - INSTALLATION AND REMOVAL)
  - WHEN DISCOVERED DATA
    - ■ COLUMN I
    - ■ DEFERRED MAINTENANCE ITEMS
    - ■ ABORT DATA RECORDING
    - ■ MULTIPLE PARTS USAGE
  - SPACE FOR WORK UNIT CODE

WHEN DISCOVERED CODES

1	MISSION ABORT-BEFORE FLIGHT
2	IN-FLIGHT ABORT
3	PRE-FLIGHT/FLIGHT READINESS INSPECTION (FLIGHT CREW)
4	DAILY INSPECTION (PMD)/AFTER FLIGHT/ BETWEEN FLIGHTS
5	TEST FLIGHT/MOC/IN-FLIGHT (NO ABORT)
6	PMP/PHASED INSPECTION
7	SPECIAL INSPECTIONS
8	ALL OTHER
9	PMI INSPECTION

Figure 12. Project Inspect Logbook Addition, Card 1 - Side 1.

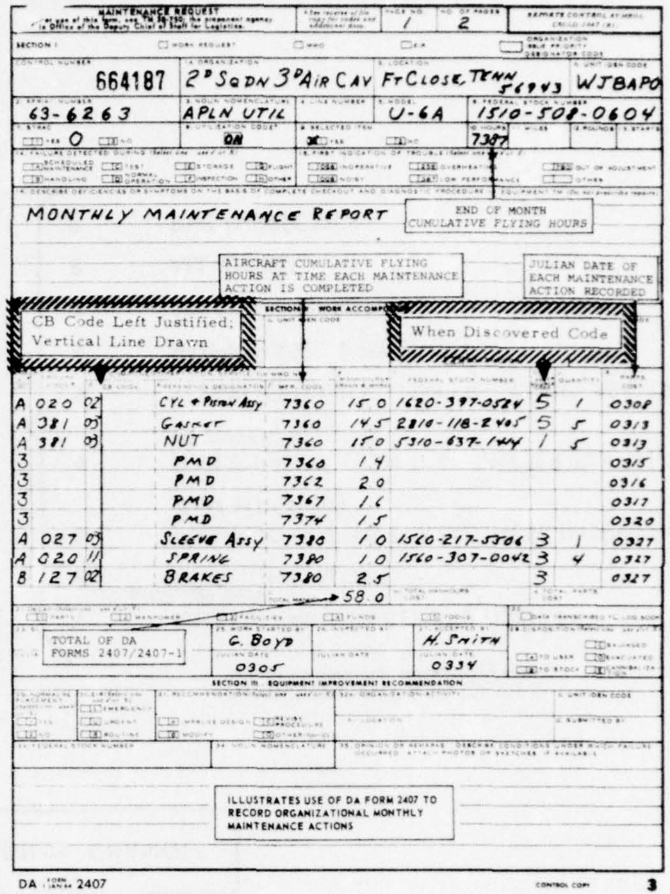


PROJECT INSPECT DATA RECORDING

Use WHEN DISCOVERED CODE when reporting that a system, subsystem, component or part has been repaired or replaced or is known to be defective or has caused an aborted flight or mission. Data is to be reported on a daily basis as shown:

- DA Form 2407, Block 20, Column i
- DA Form 2408-13, Block 17

This single-digit code indicates when the need for a maintenance action was discovered and will be used by Project Inspect analysts to determine when to inspect that component or part. In addition, leave room for a 5 digit code in Block 20d. on DA Form 2407, 2407-1 as illustrated.



2

Figure 13. Project Inspect Logbook Addition, Card 1 - Side 2.

WHEN DISCOVERED CODES

CODE	DESCRIPTION
1	MISSION ABORT - BEFORE FLIGHT - - This code is used when a need for maintenance is discovered by a flight crew before flight and it is necessary to abort the mission. This decision is usually made during flight crew pre-flight inspection or pre-start procedure/after engine start-run-up procedure.
2	IN-FLIGHT ABORT - - This code is used when a need for maintenance is discovered in-flight and it becomes necessary to abort the mission.
3	PRE-FLIGHT/FLIGHT READINESS INSPECTION (FLIGHT CREW) - - This code is used when a need for maintenance is discovered by flight crew before flight and/or during a pre-flight inspection <u>and it is not necessary to abort the mission</u>. It is also used for maintenance needs discovered during pre-test procedure/after engine start/run-up procedure when the mission is not aborted.
4	DAILY INSPECTION (PMD)/AFTER FLIGHT/BETWEEN FLIGHTS - - This code is used when a need for maintenance is discovered during a post flight/daily inspection.

This code is also used when a need for maintenance is discovered after completion of a flight or between two flights. Examples are:

1. A pilot, alighting from an aircraft after completing a photo mission, notices that an access panel is missing from the tail section.
2. During a passenger stop, a pilot notices a sudden drop in fuel pressure.

In addition, this code is used when a need for maintenance is discovered between flights by personnel other than the air crew. (Example: A mechanic notices an oil leak from an engine while directing a pilot to a parking position.)

3

Figure 14. Project Inspect Logbook Addition, Card 2 - Side 1.

WHEN DISCOVERED CODES

CODE	DESCRIPTION
5	TEST FLIGHT/MOC/IN-FLIGHT - NO ABORT - - This code is used for all needs for maintenance discovered during a test flight or maintenance operational check which was conducted for the purpose of testing installed aircraft and engine accessories and/or equipment or when a need for maintenance is discovered in flight and it is not necessary to abort the mission
6	SCHEDULED INSPECTION (PMP, PHASED) - - This code is used when a need for maintenance is discovered during a PMP or Phased scheduled inspection.
7	SPECIAL INSPECTIONS - - This code is used when a need for maintenance is discovered during those inspections published in the Organizational Maintenance Manual (-20). Typical of these inspection conditions are spectrometric oil analysis, after a hard landing, after sudden stoppage, after main rotor overspeed, after excessive engine torque, whenever an aircraft has been subjected to a compressor stall, after helicopter is flown in a loose grass environment, after engine overtemperature, after engine overspeed, internal inspection of engine, engine post installation inspection, when engine accessory drive gearbox has oil pump drive pad with only one lubricating hole, etc.
8	ALL OTHER - - This code is used when a need for maintenance is discovered on systems, subsystems, components, etc. during acceptance inspection, transfer inspection, inspection of aircraft in storage or during an activity not covered by Codes 1 through 7 or 9.
9	INTERMEDIATE SCHEDULED INSPECTION (PMI) - - This code is used when a need for maintenance is discovered during a PMI scheduled inspection.

4

Figure 15. Project Inspect Logbook Addition, Card 2 - Side 2.

3. Collection of field data and back-data from all participating aviation companies.
4. Recording of special TAMMS entries (Work Unit Codes) and special data form entries (Abort data).
5. Continuous monitoring of data for correctness, validity, and accuracy.
6. Monthly forwarding of data to the RCA plant, Burlington, Massachusetts for computer reduction and analysis.
7. Preparing and forwarding monthly activity reports to the RCA Program Manager.
8. Providing on-the-job instruction in the inspection and data collection procedures and methods.
9. Reporting to appropriate channels any indications of action, inaction, or trends that might jeopardize the validity of the test.
10. Seeking means for improving the inspection procedures and the data collection process.

The RCA field supervisor assisted by his clerk/secretary, an Army Sergeant and an AVSCOM field representative were responsible for these activities throughout the field evaluation program.

Orientation Briefings

Briefings were given to all participating Army personnel starting with command and maintenance officers on 19 June 1974. The schedule utilized for the participating companies was as follows:

D/158 (Test)	27 and 28 June (a.m.)
B/158 (Control)	28 June (p.m.)
B/101 (Test)	1 and 2 July
C/101 (Control)	3 July
D/101 (Test)	8 and 9 July
C/158 (Control)	10 July

Additional briefings were also given for new personnel and for personnel away on leave, or engaged in operational exercises away from Fort Campbell. Due to the high turnover of Army personnel, briefings were given throughout the field test evaluation approximately on a bi-weekly basis.

Data Recording

Data Recording for Project Inspect was highly dependent on established TAMMS system data procedures. In addition, the When Discovered Code (a single-digit number) was added to the report forms when a system, subsystem, component or part had been repaired or replaced or was known to be defective or had caused an aborted flight or mission. The Project Inspect computer program processed DA Forms 2407, 1352, and abort data. Therefore, throughout the program, it had to be assured that all coded and printed information entered on the maintenance forms was accurate and clearly written so that keypunch machine operators could read and enter the information on punched cards. The computer-processed data results were given to the Army to allow assessment of the progress and to validate the test. Incomplete information furnished to the computer resulted in rejection of that particular line of data. During the phase-in monitoring period, the field representatives noticed many discrepancies with normal TAMMS reporting. Errors, omissions, etc., had to be reduced through monitoring, command emphasis, and further classroom instruction by Army maintenance management personnel and the field representatives. In some cases, changes had to be made to meet the requirements of the Data Collection Plan. Data recording deviations noted by analysis of back data 2407 MMR's, work requests and other data forms plus discussions held at each company briefing were as follows:

1. Total man-hours on a PMD, PMI or PMP included inspection and maintenance man-hours as recorded on the 2407 MMR, but components replaced were not indicated. This was apparent when PMD times varied from 2 to 9 hours.
2. Time change items were recorded on the 2410 form but not on the 2407 form by all companies.
3. Integrated DS-1 support was accomplished through either a 2407 Work Order or a verbal request. This variability made it impossible to track man-hours of DS-1, which was a part of organizational level maintenance (unless the field representatives reviewed all 2407s, DS-1 man-hours did not generally appear on the MMR).
4. Removal and replacement time of engines was generally shown on the 2407 Work Order, not the 2407 MMR.
5. If an engine was transferred from one aircraft to another, a 2410 form was made out (particularly if the transfer was to GS or Depot level maintenance); however, the man-hours

required for removal, switching and replacing the engine may not have been recorded on any DA form. This should have been recorded on the 2407 MMR if performed by organizational personnel or on the 2407 Work Order if performed by integrated DS-1 personnel.

6. Time change item work was performed by organizational or DS-1 personnel. This data was entered on the 2408-16 and 2410 (if required as a repairable item) but was not recorded on the 2407 MMR or the 2407 Work Order as required.

7. Many components replaced on unscheduled maintenance were not recorded on the 2407 MMR. Thus, the maintenance man-hours for each company varied with their record-keeping technique.

8. 2404 forms are used to indicate failures noted during an inspection. Many times even though components were replaced, there was not a DA form showing what they were. This data should have been recorded on the 2407 MMR or the 2407 Work Order, depending on who did the work.

9. The description or nomenclature on the DA Form 2407 did not always agree with the FSN. For example, the rod end bearing that connected to the damper assembly might have been replaced, but the FSN for the damper assembly was recorded rather than the bearing.

These kinds of recording deviations soon caused a further study of the problem by the field representatives. It was found that Army personnel commonly had little or no training on the requirements of TAMMS as specified by TM38-750. On-the-job training was not sufficient to overcome this wide lack of knowledge. The troops involved did not know how to interpret DA Form 2407 requirements or how to fill out the forms. This caused the field representatives to conduct intensive data recording instructional classes and discussion periods. These classes were held weekly throughout the field test. RCA also produced a Data Recording Guide (Reference 1) which was used in the classes and by personnel filling out the 2407 forms in each company.

Phase-In Monitoring Completion

In addition to the phase-in of the test aircraft to the new inspection system, phase-in monitoring consisted of determining if the new inspections were performed accurately and effectively and if the data recording was being performed by Army personnel in accordance with the Data Collection Plan. On schedule, success-

ful completion of these conditions was thought to be improbable in July 1974 due to the following:

1. Low level of manning at Fort Campbell. Some crew chiefs had to handle as many as four aircraft.
2. Fort Hood reported that 2 to 3 months were required for the inspection personnel to become acquainted with the new phased inspection.
3. All participating companies were to be involved in operational exercises at locations other than Fort Campbell for most of the summer of 1974.
4. Data recorded was in many cases slightly different from TAMMS requirements.
5. A substantial turnover of personnel was anticipated.

However, since the back-data gathering and the aircraft phase-in was proceeding smoothly, a decision was made by the COTR with concurrence of the Project Inspect Project Officer to officially start the field evaluation on 21 August 1974. This date constituted the completion of phase-in monitoring. The largest problem anticipated was in the attainment of uniformly recorded data as stated in item 4 above. To aid this goal, the Army appointed a NCO experienced with inspection procedures in each company to monitor the MMRs and to assist the field representatives. This was to aid in the conduction of the test and to relieve the high workload of the field representatives.

Checklists

The checklists printed were developed over one year prior to the start of Phase II. Since that time, change notices have been issued on the PMP and PMI inspections. These changes were not incorporated into the phased checklist in July 1974. Additionally, changes had been suggested by Fort Campbell Army personnel which would improve checklist content or make checklist use easier and more uniform with current operational practices. All changes and suggestions were reviewed by RCA and KAMAN engineering personnel. Items that were required or had high merit were approved for checklist inclusion and given to the COTR. It was recommended that these changes be incorporated, the checklist be retyped horizontally on the pages (parallel to long side of page), and three holes punched to make it compatible with log-book size and format. Additional changes such as the provision of a signed approval space for each area (requested by Army personnel) were

also noted at the time. Solution to these checklist problems was accomplished as follows:

1. Change notice and checklist errors were handled immediately by the field representatives. They manually addended several checklists and gave them to the test companies using the phased inspection method.

2. Format and related improvement/use changes were held until the checklist update activity was initiated. This allowed "equivalent" (similar) checklists to be used and thus improve Test conditions during the field evaluation.

FIELD TEST MONITORING AND REPORTING

The task of field test monitoring and reporting involved the collection, monitoring, transcription and submittal of field data to RCA from three control companies and three test companies of UH-1H helicopters from the 101st and 158th Battalions at Fort Campbell, Kentucky. Activities of the field representative office were as follows:

1. Continuous monitoring for potential safety problems.
2. Monitoring of the testing and reporting of problems in inspection system implementation and data collection that may jeopardize testing validity to the Project Inspect Project Officer and to the RCA program manager.
3. Collection of field data and back-data from all participating aviation companies.
4. Recording of special TAMMS entries (Work Unit Codes) and special data form entries (Abort data).
5. Continuous monitoring of data for correctness, validity, and accuracy.
6. Monthly forwarding of data to the RCA plant, Burlington, Massachusetts for computer reduction and analysis.
7. Preparing and forwarding monthly activity reports to the RCA Program Manager.
8. Providing on-the-job instruction in the inspection and data collection procedures and methods.
9. Reporting to appropriate channels any indications of action, inaction, or trends that might jeopardize the validity of the test.
10. Seeking means for improving the inspection procedures and the data collection process.
11. Gathering and assessing possible improvements to the Phased Inspection Checklist.

The RCA field supervisor, assisted by his clerk/secretary, an Army Sergeant, and an AVSCOM field representative, was responsible for these activities throughout the field evaluation program.

This section covers the accomplishment of these activities, the problems encountered, and how many of them were solved. Information on data recording, training, data submitted, field monitoring, and miscellaneous problems are included.

FIELD DATA SUBMITTED

Data submitted from Fort Campbell consisted of three types:

1. Abort Data
2. 1352 Data, Aircraft Status and Flying Time
3. 2407 Data, Organizational/Direct Support Monthly Maintenance Accomplishments.

The gathering of these three data types and associated monitoring of data recording of forms feeding these three types formed the bulk of the field representative work. Every single line of the three types of data was reviewed, handchecked, corrected and in the majority of cases transcribed onto computer keypunch forms. A measure of the success of this activity is the quantity of data submitted shown in Table 1. Of the total lines submitted each month, 120 lines were 1352-type data and approximately 28.5 lines were abort data. The remainder of the lines submitted were 2407 data, monthly maintenance activity. The abort data was new to the Army and was used by Project Inspect to calculate aircraft mission reliability and flight reliability. Appendix V of Reference 1 demonstrates the success that Army personnel had in coping with this new variable. Aborts were noted by Army personnel on DA Form 2408-13. However, that form seldom provided sufficient information for the RCA field representative to complete the Project Inspect abort form. Therefore, it was up to him to locate the individual who recorded the abort to determine the full Project Inspect data entry.

MAJOR PROBLEMS ENCOUNTERED

A summary of the problems encountered at Fort Campbell is provided in Table 2. Most of the problems noted are those peculiar to the modern Army and not in any way indicative of subpar performance of the 101st Airborne Division. In fact, the interest and cooperation of the participating forces at Fort Campbell was outstanding. Reception of the phased inspection checklist was excellent and proves that this form of inspection can easily be integrated into the entire Army aviation fleet. Table 2 is mostly self-explanatory as the problem, noted effect, and current status or problem solution is given. Some further notes furnished by the RCA field representative follow:

TABLE 1. DATA SUBMITTED AND FLYING HOURS ACCOMPLISHED, BY MONTH.

MONTH	1 SEPT	2 OCT	3 NOV	4 DEC	5 JAN	6 FEB	7 MAR	8 APR	9 MAY	10 JUN	11 JUL	12 AUG	13 SEPT	14 OCT	15 NOV
	1974				1975										
Total Lines of Data Submitted	3060	3380	3750	3050	2190	3100	3500	3884	3798	4660	3800	4240	3783	3346	4103
Test Group															
Aborts Submitted	23	23	23	10	3	6	14	24	17	10	9	17	18	27	7
Flying Hours	1236	1309	1146	782	344	1094	916	1654	1276	2079	1613	1543	1255	1541	1693
Control Group															
Aborts Submitted	17	15	12	8	3	4	6	15	21	15	12	17	27	13	12
Flying Hours	1362	1304	1311	931	256	960	739	1156	1263	1770	1570	1611	1244	1509	1875

TABLE 2. MAJOR FIELD TEST PROBLEMS.

Problem	Effect	Resolution/Status
A/C User Funds Shortage	Higher Downtime, Abnormal NORS Condition	Temporary Problem
Fuel Shortage	Low Utilization; Increased PMD Times, Number of Periodic Run-Ups, and Unscheduled Services Using Small Parts (gaskets, etc.)	Temporary Problem
Personnel Shortage	Maintenance Work Sent to Higher Level, Increase in Major Inspection Times	Continuing Problem
High Aircraft Turnover	Insufficient Time to Evaluate Impact of Phased Inspection on Some Aircraft	Typical Operation
High Personnel Turnover	Requirement for Continual Training, Increased Field Representative Monitoring, Variability in Data Quality	Typical Operation
Unnecessary Data Recording (Similar Entries on Several Forms)	Extensive Maintenance Time Involved in Keeping Records, Increases Data Recording Errors	Unresolved
Army Personnel Not Familiar With TM 38-750	Incorrect Data Recording	Continuing Problem Field Representative Training Required
Verbal Work-Order Requests Used	Incomplete Data Reporting	Eliminated Via Organizational Updating of Responsibilities

TABLE 2. MAJOR FIELD TEST PROBLEMS (Continued).

Problems	Effect	Resolution/Status
Collection of Data From Remote Exercises	Data Delays, Loss of Data	New Methods of Submitting Data Established
Gathering Data From Higher Maintenance Levels	Field Representative Workload Increased, Additional Training Required	Interface Established is Probably Temporary
Variability in Inspection "Look-Time" Reporting	Inconsistent Data Recording	Data Recording Guide Prepared and Distributed, Increased Training Undertaken
Loss of Data Upon Aircraft Turn-In	Reduction in Data Base	New Procedures Established to Retrieve Data
Inconsistent Reporting of Service Actions That Occur at 25 FH Intervals	Data Base for Scheduled and Unscheduled Time Incorrect	Service Actions Added to Organizational DA Form 2408-18, Specified in Data Recording Guide
Different Records of Some Items Not In Agreement (Failure Codes, FSN's, MH)	Incorrect Data Recording	Unresolved - Intensive Monitoring of Project Inspect Required Records Employed
Data Recording Not Performed - "I Forgot"	Loss to Data Base	Local Directive Instituted to Require Daily Recording
Non-Uniform Inspection and Maintenance Procedures Employed (Due to Organizational Personnel and Skill Shortages)	Initial Poor Data Recording	"Work-Around" Procedures Suggested and Employed. Additional Training Used For Inspection Teams.

1. Shortage of funds produced an abnormal NORS condition and meant a higher downtime.
2. Shortage of fuel meant low utilization, which in turn, caused an increase in unscheduled services, more maintenance on such components as seals and gaskets, periodic run-ups, and longer PMD times.
3. Personnel shortage tends to first increase downtime during a major inspection to the point where a Phased Inspection might have the same downtime as a heavy PMP, and second, cause work to be sent outside of organizational maintenance to higher levels.
4. The large turnover of aircraft meant fewer would stay in the phased concept for the field evaluation period. As a matter of fact, one or two aircraft did not make the first 100-hour phased inspection interval before turn-in, so the data was of little value other than helping to show what components were replaced, etc.
5. The approximate 75 percent turnover of personnel during the entire program necessitated a continual training program on data recording; the loss of key personnel such as Technical Inspectior, 67 N maintenance personnel, company monitors, and AMO's created a heavy burden on the field representative team. It was their job to continually produce valid data, achieve uniform data reporting, and correct mistakes or omissions on the 2407s. This was one of the reasons the received data quality varied from month to month throughout the program. A loss of trained personnel presents a hardship to any company, which in turn affects the data quality. Time spent on records was always affected, and this resulted in some nonproductive maintenance.
6. Army personnel were not familiar with the 2407 recording procedures and other aspects of TM38-750. This created a need for additional training above and beyond the original plan. This need was found before the Project Inspect evaluation could get underway and continued throughout the 15 months of the test.
7. Maintenance "work ordered" verbally never appeared on a 2407, neither was it submitted via other TAMMs records. For example, specialized maintenance work, Integrated Support (ISDM) activity, and special inspections were often requested verbally. Verbal requests resulted in incomplete data reporting; this became apparent when 2410 and 2408-16 component maintenance actions, special inspections, and

major inspection action items were not recorded on the 2407 form although they were indicated on the 2408-13s or 2404s as accomplished. Analysis of each company's organizational maintenance structure was then pursued; recommendations were given that were compatible with the existing organizations indicating how this data should be recorded.

8. Collecting and monitoring the data on aircraft operating away from the local activity created an undesirable delay in transcribing the data for the RCA field office. To prevent a backlog, lines of communication and field methods of submitting data were established. However, delays still occurred because many times the data was erroneous and incomplete. The answers required could only be obtained when the aircraft logs, records and personnel returned.

9. The new requirement to include data from direct support maintenance activity in addition to organizational activity caused an additional field office workload. The added workload included copying, monitoring, and data analysis tasks, training of direct support personnel, and distribution/printing of orientation and data-recording guides.

10. Inconsistencies in the data recording of the "look" times of PMDs, PMIs, PMPs, and Phased inspections were found. Directions on what could be lumped under these inspections and still conform to TM38-750 had to be established and distributed or taught to Army personnel. Orientation classes and the Project Inspect Data Recording Guide were extremely useful in establishing a uniform data base. Before this situation was solved, PMDs varied from 1.5 to 12 hours, PMIs 6 to 50 hours, PMPs 80 to 700 hours and Phase inspections 40 to 300 hours.

11. Inconsistencies also occurred in the reporting of scheduled and unscheduled man-hours. This happened with records using action codes 1 and 2 or When Discovered Codes (WDCs) 7 and 8. The result was a bias in the comparison of scheduled and unscheduled man-hours between the test and control group. Therefore, additional orientation, changes in methods of monitoring 2407s, and discussions with individual Army personnel had to be employed. When new personnel became involved in the reporting cycle, all efforts had to be repeated.

12. Loss of 2407 data when an aircraft was turned in before the reporting period was over resulted in a loss of maintenance data from 5 to 20 days for some aircraft. Procedures had to be establsihed to retrieve this data before the records

left the company or the local Accident Board, whichever was the case.

13. Inconsistencies in reporting PMI scheduled services for the test companies occurred. For example, action code 4 was used when it should have been a 1 or the wrong When Discovered Code was used when for example, a Parts Kit was replaced. Some companies also used the WDC-7 when is should have been a WDC-3. These mistakes in recording made the data incorrect, as test companies do not perform PMI inspections (action code 4) or replace components during scheduled services as unscheduled man-hours (WDC-7). This was another problem resolved by class discussion and the Project Inspect Data Recording Guide.

The data review and the correction and analysis process compelled the field office to adopt the most practical solution available as each problem arose. Their approach had to be: What data is valid, what is not? How do we correct this deficiency? How much time can we spend on an item to correct the problem without jeopardizing the rest of the task? Field monitoring indicated that valid data is not easily obtained without a large field office force; however, constant guidance, working closely with the personnel involved, reviewing data before transcription, and monitoring records periodically during the month solved most of the problems. As Army personnel became familiar with the Project Inspect program, they improved their recording procedures and reduced their errors. To further improve the data collection accuracy, however, would require increased training, conscientiousness, monitoring and controlled conditions not practical in a typical Army operating helicopter company.

SUGGESTIONS FOR ARMY DATA COLLECTION IMPROVEMENT

Considerable time is spent on maintaining records such as the 2408-13, 2408-16, 2408-18, 2408-15, etc., plus filling out cannibalization FC Form 880s, 2404s, 2407s and 2410s. Since many of these documents have similar entries, a consolidation of records will ease record-keeping chores. It is suggested that all daily actions be entered on fewer forms or logs to reduce duplication. For example, the 2407 might be reduced in size to fit in the log book where it is accessible for daily entries. Then, instead of being the rough work copy at the end of the month's effort, it will become the final copy submitted to TAMMs records. This would save time and paper. It is also suggested that the 2407 be revised to function in a capacity other than as an MMR, MWO entry or Work Order. It can also be used to replace the FC Form 880

(if cannibalization is authorized) and with modification, the 2404. Constant monitoring of these records during the 15-month Project Inspect effort showed many disagreements between them. When the disagreements were noted, the question always was "which is right"? Reduction of forms might eliminate this problem. For example, a failure code discrepancy often occurred between the 2410 and 2407. Many times people used an 803 failure code, merely because the component was a time change item, when actually the failure code should have been an 020 or a 190.

TRAINING PROBLEMS

Training was generally adhered to as originally planned. Orientation briefings were given to over six hundred people. These briefings were given more frequently than planned to account for the heavy turnover of personnel. The orientation briefings were also heavily supplemented by data recording training and discussion sessions. These were established due to the problems recounted in previous paragraphs.

MISCELLANEOUS FIELD REPORTS

Additional tasks were performed by the field office in the way of obtaining answers to specific questions and analyses in several data areas. This subsection presents information of that nature, including engine repair/overhaul cost data gathering, aircraft turnover, personnel turnover, checklist analysis, and service actions.

Engine Replacements/Repairs

During the program it was noted that the engine is the most expensive component carried on the Project Inspect spares utilization computer listing. Moreover, when an engine was replaced, the full spares dollars were charged to that aircraft. This dollar value is so large that a couple of engines can easily swing the higher total dollar cost magnitude from control group to test group and vice versa. Under the current recording scheme, an engine could be removed and be replaced with one from the maintenance float. That same engine could be tested by GS, adjusted, and placed back into the float. However, the actions were not tracked and the data management system charged the total new engine replacement costs against that aircraft. Another case was modular repairs made to the engine by DS or GS. Again, full cost was charged against that aircraft. High time-consuming engine repairs are usually performed by the depot. A partial overhaul

or major module replacement must cost less than the full cost of a new engine. Thus, engine spares utilization costs were probably overstated.

The field office attempted to determine overhaul costs for the engine. This was determined as:

- Average Depot Overhaul Cost $13,600
- Average Depot Repair Cost $ 7,623

However, when the RCA field representative tried to follow General Support 2407 engine work orders he ran into problems. Due to the time delay between the removal of the engine from the aircraft and the determination of the engine components required to make it serviceable, he was unable to assign a specific GS repair value to the engine in the time frame required by Project Inspect.

Aircraft Turnover

Although aircraft were turned in occasionally during the program, this activity was particularly heavy during the last four months. During that time, fourteen aircraft were replaced due to the on condition maintenance (OCM) program, extensive maintenance requirements and crash damage. Out of the field test complement of 120 aircraft monitored during the formal field test, 34 were turned-in. Since some of the turned-in aircraft replaced other turned-in aircraft, the effect on Project Inspect was not nearly so great. Approximately 96 aircraft were with the program long enough to average over 15 flying-hours per month. The list of aircraft replaced with the replacement reason follows:

Company	A/C No.	(Replacement)	Date Turned-In	Reason
B101	65-10048	(68-16245)	8/74	OCM
	64-13861	(73-22099)	3/75	Ext. Maintenance
	71-20164	(66-16873)	4/75	Deck Separation
	73-22099	(71-20164)	5/75	Fuel Contamination
	69-15903	(66-16450)	9/75	OCM
C101	64-13510	(68-15382)	2/75	Crashed
	66-0961	(65-10081)	2/75	Ext. Maintenance
	66-16210	(64-13592)	4/75	Deck Damage
	66-16424	(69-15350)	10/75	Main Beam
	66-16411	(66-16600)	9/75	Ext. Maintenance
	68-15366	(66-0955)	1/75	Crashed
	68-15382	(67-17848)	9/75	OCM
	68-16333	(68-15362)	10/75	Deck Separation
D101	65-10105	(67-17425)	9/74	Mechanical Failure
	66-1024	(73-21738)	7/74	OCM
	67-17832	(74-22359)	6/75	Excessive NORS
	68-15362	(65-10005)	11/74	Accident Damage
	68-15747	(65-12874)	5/75	Compressor Stalls
	68-16469	(73-22099)	9/75	Deck Sep.
	74-22359	(65-10030)	9/75	Hit by DC9
	65-10005	(71-20332)	10/75	Engine Deck
B158	63-8828	(65-9688)	11/74	Crashed
	65-9603	(69-16719)	7/74	OCM
	65-9789	(65-9682)	10/75	OCM
	65-10005	(69-15017)	8/74	OCM
	65-10030	(68-16250)	8/75	Crashed
	66-896	(65-10105)	10/75	OCM
	69-16719	(73-21806)	11/74	Crashed
C158	65-10093	(64-13721)	10/74	OCM
	66-1011	(65-9603)	5/75	Crashed
	68-15665	(65-9825)	9/74	Unsch. Turn-In/ Frame Crack
	71-20236	(67-17451)	7/74	OCM
D158	63-8837	(65-9848)	7/74	OCM
	65-10105	(68-15372)	8/75	Hard Landing
	66-0905	(68-15248)	7/74	OCM
	66-0996	(70-16298)	5/75	Cracked Xmsn
	66-16027	(63-8845)	7/74	OCM
	66-16272	(66-16234)	7/74	OCM
	68-15382	(68-16576)	9/74	Hard Landing
	68-15584	(65-10105)	4/75	Deck Separation
	69-15041	(66-935)	8/75	Crashed

Many of the aircraft turned in could not be replaced for a month or more. This meant some companies did not have the full complement of 20 aircraft during some months.

Personnel Turnover

Normal operation within the Army includes training and advancement of personnel. Many times for this and other reasons, personnel turnover is high. During Project Inspect Phase II heavy personnel changes occurred. The status of personnel turnover was checked twice during the program with the following results:

- May 1974 to November 1974 - 64 Percent Turnover
- May 1974 to May 1975 - 75 Percent Turnover

The high turnover made it difficult to maintain a smooth data flow at times. Key people who were trained and experienced with the phased inspection system and Project Inspect's data collection requirements were continually replaced. This included technical inspectors, platoon leaders, crew chiefs, data monitors, ISDM leaders, company AMOs, Battalion AMOs, and company COs. Constant training of new people had to be employed to make the program successful.

Another related area of personnel impact was the under TOE strength of many of the organizations and in particular, the lack of skilled personnel existing in them. A shortage of 67Ns prevailed throughout the entire 15 month test program. Skilled personnel in the company integrated support area ISDM was acute at times. This included skilled maintenance men such as hydraulic, power train, engine and rotor specialists, machinists and sheet metal workers.

Phased Checklist Monitoring and Update

The Project Inspect Phased Inspection Checklist was continually revised and kept up to date. New changes and revisions to the PMI and PMP as the result of Army TWXs, etc., were reviewed and manually incorporated into the Phased Inspection Checklist. In addition, all critical inspection step TM paragraph references were updated to agree with the latest manuals.

The tested phased checklist incorporated too much up and down climbing on the aircraft. For example, in area 3, step 1 the inspector is required to go on top of the aircraft; step 8 the side of the aircraft; and step 12 underneath the aircraft.

Therefore, areas and steps had to be revised during the checklist update activity so that the inspection could normally proceed CCW or CW around the aircraft with a minimum of climbing.

Along this same line of thought, improvements to the inspection step wording were recommended. In several areas, a panel or access plate is opened to check only a few items every phase. Its only normal for an inspector to look at everything that is exposed under that plate or panel rather than every other time for example. The difference in inspection time is believed to be insignificant. In some cases it takes only a glance to check a defect or crack, in the now noninspected component. The solution would be to place all components exposed into the same inspection time interval.

Work was also performed on a preliminary checklist redesign effort to improve the current phased inspection checklist. A reorganization of inspection areas, inspection steps, and changes in instructional wording was accomplished using a "common sense" human factors approach. Discussions with Army Technical Inspectors and other maintenance personnel were of great assistance in this task.

Service Actions

Inconsistent reporting of service actions during the early stages of Project Inspect pointed out the need for direction and a new method for keeping track of the 25-hour service actions that are still required in conjunction with the phased inspection checklist. As recommended by the Data Collection Plan, these items were noted and placed on the Equipment Inspection List, DA Form 2408-18, carried aboard each aircraft. Figure 16 is a copy of the Equipment Inspection List required to be used with the new phased inspection checklist.

1. NOMENCLATURE	2. MODEL	3. SERIAL NUMBER	4. PAGE NO. 1 / NO. OF PAGES 1
HELICOPTER, UTILITY TACTICAL TRANSPORT	UH-1H		

5. ITEM TO BE INSPECTED	6. REFERENCE	7. FREQUENCY	8. NEXT DUE
T/R Lube Due	TM55-1520-210-20	25 Hours	
(7) T/R P/C Links Disconnected	TM55-1520-210-20	25 Hours	
Engine Oil Sample Due	TM55-1520-210-20	$12\frac{1}{2}$ and 25 Hours	
Transmission Oil Sample Due	TM55-1520-210-20	25 Hours	
42° G/B Oil Sample Due	TM55-1520-210-20	25 Hours	
90° G/B Oil Sample Due	TM55-1520-210-20	25 Hours	
Hydraulic Oil Sample Due	TM55-1520-210-20	25 Hours	
(7) 90° G/B Mag Plug Removed	TM55-1520-210-20	25 Hours	
(7) 42° G/B Mag Plug Removed	TM55-1520-210-20	25 Hours	
(7) Xmsn Mag Plug Removed	TM55-1520-210-20	25 Hours	
(7) Engine Servo Filter Removed	TM55-1520-210-20	50 Hours	
Clean and Inspect M/R Blades	TM55-1520-210-20	25 Hours	
First Aid Kit PM Check	TM55-1520-210-20	25 Hours	
Fire Extinguisher PM Check	TM55-1520-210-20	25 Hours	
Nic CAD Battery PM Check	TM55-1520-210-20	25 Hours or 7 days	
Outer Control Plate Trunions Lube	TM55-1520-210-20	50 Hours	
Collective Lever Trunion Lube	TM55-1520-210-20	50 Hours	
Control Plate Trunion Lube	TM55-1520-210-20	25 Hours	

DA FORM 2408-18, 1 JAN 64

EQUIPMENT INSPECTION LIST
(TM 38-750)

Figure 16. Project Inspect Subinterval Service Actions.

DATA REDUCTION AND ANALYSIS

Data analysis during Project Inspect primarily used engineering man-hours to double-check field data, to correct obvious data card inputs to the Data Management System, and to perform monthly results analysis. Three other tasks are the analysis of raw field data, monthly data processing, and MAVIS data base update. Analysis of raw field data was performed by the field office at Fort Campbell. Monthly data processing and MAVIS data base update management system. This portion of the report addresses the monthly program results and recounts some of the analyses performed during the program. In particular, comparisons between the test group and the control group are addressed. Topics covered include utilization achieved, early data recording problems, major inspection times and inspection MMH/FH, PMD times, OR, NORS, NORM, reliability, WDC differences, and spares usage.

PROJECT INSPECT PHASE II GOALS

The major goals of the field evaluation of UH-1H helicopter inspection systems program (Project Inspect-Phase II) were:

- To Validate the MAVIS Model's Capability to Produce Inspection Schedules and Checklists Which Provide Increased Operational Readiness at Reduced Cost Without Jeopardizing Aircraft Safety.
- To Refine the MAVIS Model to Improve its Accuracy Based Upon Field Experience.
- To Refine the UH-1H Phased Inspection Checklist Based on an Accurate Failure Data Bank (36,000 flying hours).

Other goals included a determination of the acceptance of a phased inspection schedule by an operational Army group and turnover of the MAVIS Model to the Army.

The above goals are mentioned to clarify a misunderstanding about the data gathered during Phase II. The gathered data was thought by some to be a controlled experiment such as a test that MASSTER might run. This is not true. The data gathering of Project Inspect, Phase II, can best be described as a sample data program gathering a wealth of operational data including accurate DA Form

2407 (Failure) data. To further explain this, the following two points are made:

1. The Project Inspect field evaluation was not conducted in a wholly controlled environment.

   Explanation: The field exercises that the Project Inspect companies engaged in during the program presented a variation in operational environments. Different environments and different missions heavily impacted spares usage and maintenance requirements. This influence was completely independent of inspection interval changes. This influence caused data skews, which biased the comparative computed spares usage, unscheduled manpower, etc.

2. The Project Inspect monthly summary data reports were biased by inconsistent data recording practices.

   Explanation: Data is added to a cumulative data base on a monthly basis. Once a large quantity of data has been entered into the processing system that is biased in one direction, the average for that data item will be biased for the rest of the program. For example, the PMD times entered during the early months were recorded as high values in many cases. These values when averaged will always result in a "high" summary figure.

From the inception of Project Inspect Phase II with its small field monitoring capability, it was known that there would be a limitation in the data accuracy which could be achieved. However, the data that was acquired during the program is far superior in quality to that normally fed to the TAMMS system. It is believed that the failure reporting on the 2407's is of particular high quality. The high data quality provided sufficient basis for testing the validity of the MAVIS model and refining the phased inspection checklist.

EARLY DATA RECORDING PROBLEMS

The data recording problems encountered are adequately reported in the Field Test Monitoring and Reporting section of this report. However, three examples are again noted here to emphasize, in particular, the adjustment and training problems that occurred during the first few months of the program.

Problem 1: In January 1975, it was reported that PMD's consistently took longer to do by the Test Companies (96 percent more MMH/FLT-HR). PMD's normally take about 1 to 3 hours to perform.

However, the data received indicates that many of the PMD inspections took 4, 4.5, 5 and even 8 hours. Apparently, there was a tendency to be more careful during the daily inspection when the inspector knew that a more thorough inspection would not be performed for a longer period of time. It was believed that troops were accounting for their total available time in the MMR reporting process.

Problem 2: Several aircraft reported 100 percent OR for the first three months of the test. A check showed that some of these actually were not operationally ready as indicated. After eliminating maintenance man-hours for all inspections, run-ups, services and ground handling, a significant amount of repair MMH remained. In other words, correlation between 1352 data and 2407 data was poor.

Problem 3: Data recorders were failing to report the major inspection "Look" times (Phased, PMP, PMI inspections). Many times repair and replacement maintenance actions were recorded with When Discovered Codes 6 and 9 (these codes meant that the need for that maintenance action was discovered during a major inspection). This indicated to the field office reviewers that the 25-hour service or inspection and the 100 hour inspection "Look" times were omitted. This of course created problems for the data analyzers as they had to back track flying hours on each aircraft, go back to the company 2408-13s for verification, and check with the performing party to obtain the time involved.

Problem Solutions: Most of the data recording problems were solved by continual monitoring, training, and the use of discussion periods with all involved personnel. Other early problems also arose due to the readability of the forms and the lack of correct entry on them. Many corrections were performed at the RCA Burlington plant and many more were performed by the field representatives. Since keypunching directly from the 2407 forms did not work, a transcription process was employed by the field representatives. This process allowed data entry verification to occur on the spot where troop referral could correct many of the data entry problems. Thus, field data formatting (the transcription process) was performed at the best location - Fort Campbell. It was performed by a team of four, including one RCA Service Company technical representative, one AVSCOM technical representative, one RCA Service Company clerk-typist and one Army Sergeant.

UTILIZATION/FLYING-HOURS ACCOMPLISHED

The utilization or average flying-hours achieved per aircraft, by company and by group was closely tracked during the program. Utilization varied a good deal more than desired and was one of the main reasons causing the field test to be extended from 12 to 15 months. Reasons for low utilization at various times included bad weather, holidays, extensive maintenance problems, fuel allocation shortage and funds shortages. Low use appeared to generate peculiar maintenance problems such as leaking seals and gasket deterioration. Low use also causes the PMD inspection to become far more thorough, as it is believed extra care must be taken to insure adequate safety for user personnel. Figure 17 is a copy of the DMS summary results by company and group. This computer printout shows the cumulative program average utilization for each company and group. The numbers listed are relatively close. This was not always true during the program. The varied utilization results obtained can best be shown on a month-by-month basis. Figure 18 graphically illustrates the incremental monthly flying hours accomplished by the test group and the control group. Table 3 shows the same flying hour achievement but in the cumulative monthly form which was printed by the DMS each month (See Figure 17). Note that only Figure 18 highlights the monthly differences between the test and control groups. The areas on the chart where the group goal was achieved were coincident with field exercises scheduled by the 101st Airborne Division. Some of the "peaks and valleys" on the graph can be related to the comments provided in letter progress reports, excerpts of which follow:

> <u>February 1975</u>: "Due primarily to fuel shortages and fuel contract problems, the allocation of flying time is decreasing sharply. - - It should be noted that aircraft flying one or two hours per month is an abnormal situation and not one desired by Project Inspect. Not only are normal operational conditions not duplicated but aircraft maintenance varies considerably. Extremely low use generates peculiar maintenance problems such as leaking seals and deterioration of gaskets. Also, because the aircraft are seldom used, the PMD inspection must become far more thorough to insure adequate safety to user personnel. In addition, it is known that phased inspection systems are not optimum if long periods of disuse are anticipated. Evaluation of a new inspection system then becomes extremely difficult".

MONTHLY EVALUATION CRITERIA RESULTS BY COMPANY AND GROUP PAGE 43

RESULTS FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR UH-1H HELICOPTERS AT FORT CAMPBELL, KENTUCKY ON A COMPANY AND GROUP BASIS

	TEST GROUP COMPANIES			TEST	CONTROL GROUP COMPANIES			CONTROL
CRITERIA	B-CO 101ST	D-CO 101ST	D-CO 158TH	GROUP SUMMARY	C-CO 101ST	B-CO 158TH	C-CO 158TH	GROUP SUMMARY
OR PERCENT	75.7	76.0	78.8	76.9	73.4	78.6	75.4	75.8
NORS PERCENT	9.2	5.3	3.6	6.1	10.6	6.0	10.8	9.2
NORM PERCENT	14.2	16.3	15.2	15.2	13.6	12.9	12.6	13.0
RMC PERCENT	26.9	26.0	21.7	24.8	8.0	11.0	3.1	7.4
AVE UTILIZATION	20.7	21.3	23.0	21.6	20.1	22.5	20.3	21.0
R_M	98.2	98.9	98.1	98.4	98.4	98.8	98.6	98.6
R_F	98.9	99.2	98.7	98.9	99.2	99.3	99.1	99.2
MMH PER FLT-HR	4.09	3.99	4.83	4.32	4.52	5.22	5.15	4.97

Figure 17. Company and Group DMS Summary Results.

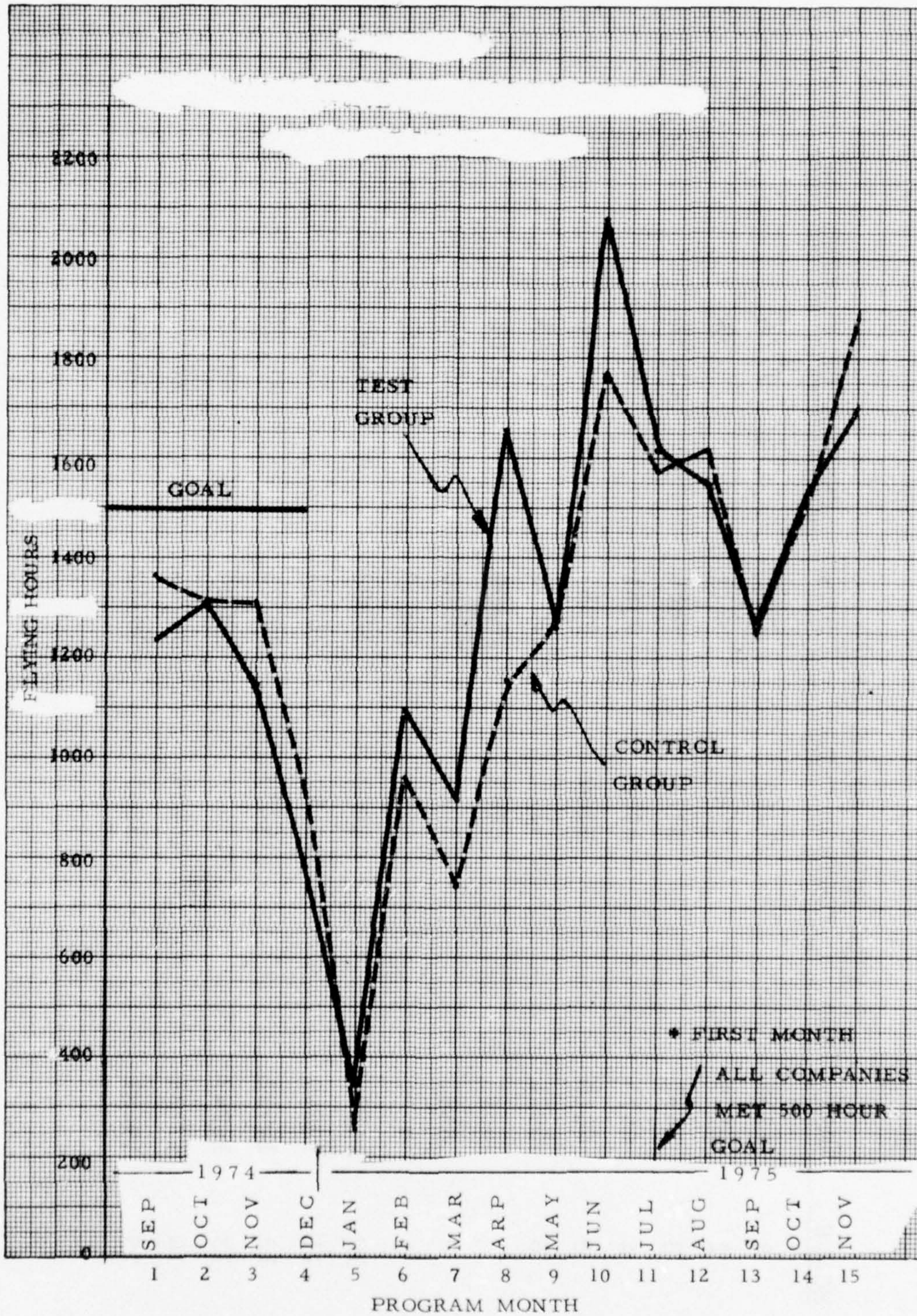


Figure 18. Group Monthly Flying Hour Accomplishment.

TABLE 3. PROJECT INSPECT CUMULATIVE FLYING HOUR SUMMARY.

	FLYING HOURS ACCOMPLISHED			
MONTH	TEST GROUP	CONTROL GROUP	TOTAL	PERCENT OF PLANNED GOAL
1	1236	1362	2598	7.2%
2	2545	2666	5211	14.5%
3	3691	3977	7668	21.3%
4	4473	4908	9381	26.1%
5	4817	5164	9981	27.7%
6	5911	6124	12035	33.4%
7	6827	6863	13690	38.0%
8	8481	8019	16500	45.8%
9	9757	9282	19039	52.9%
10	11836	11052	22888	63.6%
11	13449	12622	26071	72.4%
12	14992	14233	29225	81.2%
13	16247	15477	31724	88.1%
14	17788	16986	34774	96.6%
15	19481	18861	38342	106.5%

March 1975: -- "utilization in the December-January period was abnormally low due to the Christmas holidays and bad weather. Utilization has increased in the January-February period but still is not balanced on a company basis". - - -

"Utilization during the processed data period was extremely low. Utilization as reported resulted in low aircraft use as follows: - -".

COMPANY	NO. A/C NOT FLYING	NO. A/C FLYING 5 HOURS OR LESS	NO. A/C FLYING 5-10 HOURS
B/101	1	6	12
D/101	1	5	12
D/158	3	12	3
C/101	7	4	3
B/158	4	9	4
C/158	9	10	0

May 1975: "The primary problem the Project Inspect program has is the past accumulation of low utilization data in its cumulative data bank. Low utilization data is defined as that aircraft usage which is significantly lower than 25 hours per month. Low utilization impacts the program in two ways. The first is the resultant blurring of the distinguishing features in the comparison data of the two inspection schemes. The second is the fact that the test period will not be long enough (as judged by earlier field data sample projections) to accumulate sufficient flying hours to achieve substantive results". - - -

"Utilization for the processed period was again low. Many aircraft were used less than ten (10) hours which is extremely low compared with the goal of 25 flying hours per month. By company the following quantity of aircraft flew ten hours or less:

Company	Quantity of Aircraft with Very Low Flying Time
B/101	8
D/101	4
D/158	4
C/101	9
B/158	4
C/158	13

"It is believed the low utilization for the last three months is now affecting the cumulative data results. The comparative

differences noted previously are now in many cases becoming less distinguishable. Utilization for all aircraft over the last three months averages to 11.96 flying hours per month. All companies are at least 43 percent below the contractual goal. The three month averages by company are as follows: --"

Company	Jan-Feb-Mar Utilization Average
B/101	14.37 flying-hours
D/101	14.35
D/158	10.53
C/101	12.47
B/158	12.78
C/158	7.27

August 1975: "Utilization has improved during July as five companies flew over 500 hours. -- It should be noted that Project Inspect is a data sampling program (data gathered at Fort Campbell is a sample of the total UH-1H fleet). As such it is important to maintain even usage of all aircraft in the program. This has not always occurred due to field exercise needs, parts delivery delays, etc. Several aircraft are well below the average utilization for their respective company."

Another utilization problem that occurred and not shown by Figure 18 was the imbalance in company flying-hours. This, of course, is typical of Army operational conditions. During the middle part of the program, some companies had flown as much as 35 percent more hours than others. This problem was pointed out and Army scheduling reduced the differences to an acceptable level by the end of the field test. The lack of use of a couple of aircraft in a given company is also a typical operational practice. The need for parts, parts delivery delays and cannibalization play a key role in this occurrence. Even during Project Inspect, when commanding officer pressure was used to attempt to maintain even usage of all aircraft in the program, this problem/practice was not completely eliminated.

MAJOR INSPECTION MMH/FH

This subsection explains some of the data recording problems associated with the major inspections, discusses the different methods used to accomplish the phased inspection and presents the PMI, PMP, Phased inspection data results.

PMP/Phased Data Recording Problems

Data received on both inspection types indicated extreme variability. Normally a PMP inspection will take from 50 to 125 hours (Look Time) depending on the experience and number of personnel involved. However, the data received indicated that many of the PMP inspections took 175, 200, 260, and even 300 hours long. Variable data was received from both direct support and organizational PE teams.

Discussion of these times with the control companies and direct support personnel indicated the following:

1. There was a tendency to add the component maintenance action codes A, B, R, S, L, etc., to the PMP "Look" (code 5) time.
2. There was also a tendency to account for all hanger time even though inspection time was not involved, for example, 24 hours a day.
3. Unscheduled man-hour time such as services (action code 2) was being added to the PMP "Look" time.
4. OJT of new personnel increased the man-hours to perform the inspection.

The Phased inspection (action code 5) involved only the test companies with their organizational and integrated support maintenance functions (PE teams and ISDM). A normal Phased inspection takes from 40 to 80 hours depending on the experience and number of personnel involved. However, the data received indicated times varied from 85 to 150 hours and sometimes reached the 200-hour mark. It was noted that the inspection personnel had to become familiar with the eight phases before the "Look" times approached the above estimate. The overall average time for the phased inspection never approached the estimated time for some inspection teams in some of the companies. This may have been due to the constant personnel turnover and individual company inspection procedures.

Major inspection data recording problems were solved for the most part by careful monitoring of the MMRs, the continual lecturing and question/answer periods held on Project Inspect and data recording, and the issue of the Data Recording Guide.

Phased Inspection Accomplishment

Three test companies used the Phased Inspection Checklist; each implemented it slightly differently. Implementation was based on personnel quantity and skill capability in each case. The technical inspectors and crew chiefs accepted and adapted to the new inspection system well. The three methods employed were:

1. In one test company, the Technical Inspector (T.I.) performed all the steps.
2. In the second test company the T.I. inspected only certain steps and the crew chief the others. They performed as a team; the T.I. verified all checks made and signed off the inspection sheets. The T.I.'s steps were circled in red for each area, while the crew chief's steps were left normal. Since the crew chief also performs the PMD, it was natural to assume he could easily perform the same steps in a phased 100-hour inspection and still oversee the lubrication work, etc. With eight to eleven crew chiefs and only two T.I.'s, it was a good arrangement for that particular company. In this way the T.I. was also giving each crew chief a good, working knowledge of the phased inspection system.
3. In the third test company, a maintenance team performed the inspection. The T.I. observed and signed off the sheets, noting the discrepancies found.

Major Inspection "Look" Time and MMH/FH Results

Each month of the program the DMS calculated and printed major inspection MMH/FH by company and group. The final printout for all 15 months is shown as Figure 19. This listing contains the cumulative figures for the four inspection types and for scheduled and unscheduled maintenance actions. Table 4 provides the same inspection MMH/FH results but on a monthly basis. These were the cumulative results received each month from the DMS processing program. These listed results are difficult to follow because they are cumulative. Monthly incremental results were extracted from the data bank and plotted in graphic form. This is provided in Figure 20. It is shown that the Phased inspection consumed a lower amount of maintenance man-hours per flight-hour than the equivalent PMP plus PMI inspection. This amount was 47 percent when averaged for the entire 15 months. Figure 20 is relatively constant except for a peak occurring in January 1975. (This is the data for the period 21 December 1974 through 20 January 1975). Reference back to Figure 18 indicates this was a

MMH/FLT-HR FOR INSPECTION SCHEMES AND MAITENANCE ACTIONS BY COMPANY AND GROUP PAGE 44

RESULTS FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR UH-1H HELICOPTERS AT FORT CAMPBELL, KENTUCKY ON A COMPANY AND GROUP BASIS

ALL VALUES ARE MMH/FLT-HR

INSPECTION TYPES	TEST GROUP COMPANIES B-CO 101ST	D-CO 101ST	D-CO 158TH	TEST GROUP SUMMARY	CONTROL GROUP COMPANIES C-CO 101ST	B-CO 158TH	C-CO 158TH	CONTROL GROUP SUMMARY
PMI	0.000	0.004	0.000	0.001	0.297	0.299	0.405	0.333
PMD	1.039	1.101	1.008	1.048	0.876	0.909	0.727	0.840
PHASED	0.485	1.206	1.344	1.025				
PMP					1.746	1.828	1.218	1.604
SPECIAL	0.581	0.440	0.391	0.468	0.312	0.325	0.427	0.354
MAINT. ACTIONS								
SCHEDULED	2.330	3.109	3.422	2.972	3.717	4.530	3.828	4.044
UNSCHEDULED	1.762	0.880	1.411	1.350	0.799	0.692	1.322	0.930
TOTAL FLIGHT HOURS				19481				18861

Figure 19. MMH/FH Program Summary For Inspections.

TABLE 4. PROJECT INSPECT CUMULATIVE INSPECTION RESULTS (MMH/FH).

		TEST GROUP		CONTROL GROUP		
MONTH	ENDING	PMD	PHASED	PMD	PMI	PMP
1	9/20/74	1.430	1.176	0.951	0.549	1.752
2	10/20/74	1.500	1.284	0.864	0.442	2.194
3	11/20/74	1.609	1.307	0.819	0.419	2.015
4	12/20/74	1.582	1.293	0.854	0.413	2.042
5	1/20/75	1.640	1.300	0.900	0.409	2.253
6	2/20/75	1.551	1.218	0.938	0.392	2.076
7	3/20/75	1.520	1.271	0.959	0.387	1.987
8	4/20/75	1.390	1.217	0.966	0.390	1.920
9	5/20/75	1.327	1.217	0.938	0.368	1.889
10	6/20/75	1.226	1.181	0.915	0.359	1.809
11	7/20/75	1.178	1.102	0.890	0.347	1.704
12	8/20/75	1.151	1.080	0.877	0.341	1.731
13	9/20/75	1,123	1.057	0.865	0.355	1.679
14	10/20/75	1.086	1.036	0.846	0.346	1.630
15	11/20/75	1.048	1.025	0.840	0.333	1.604

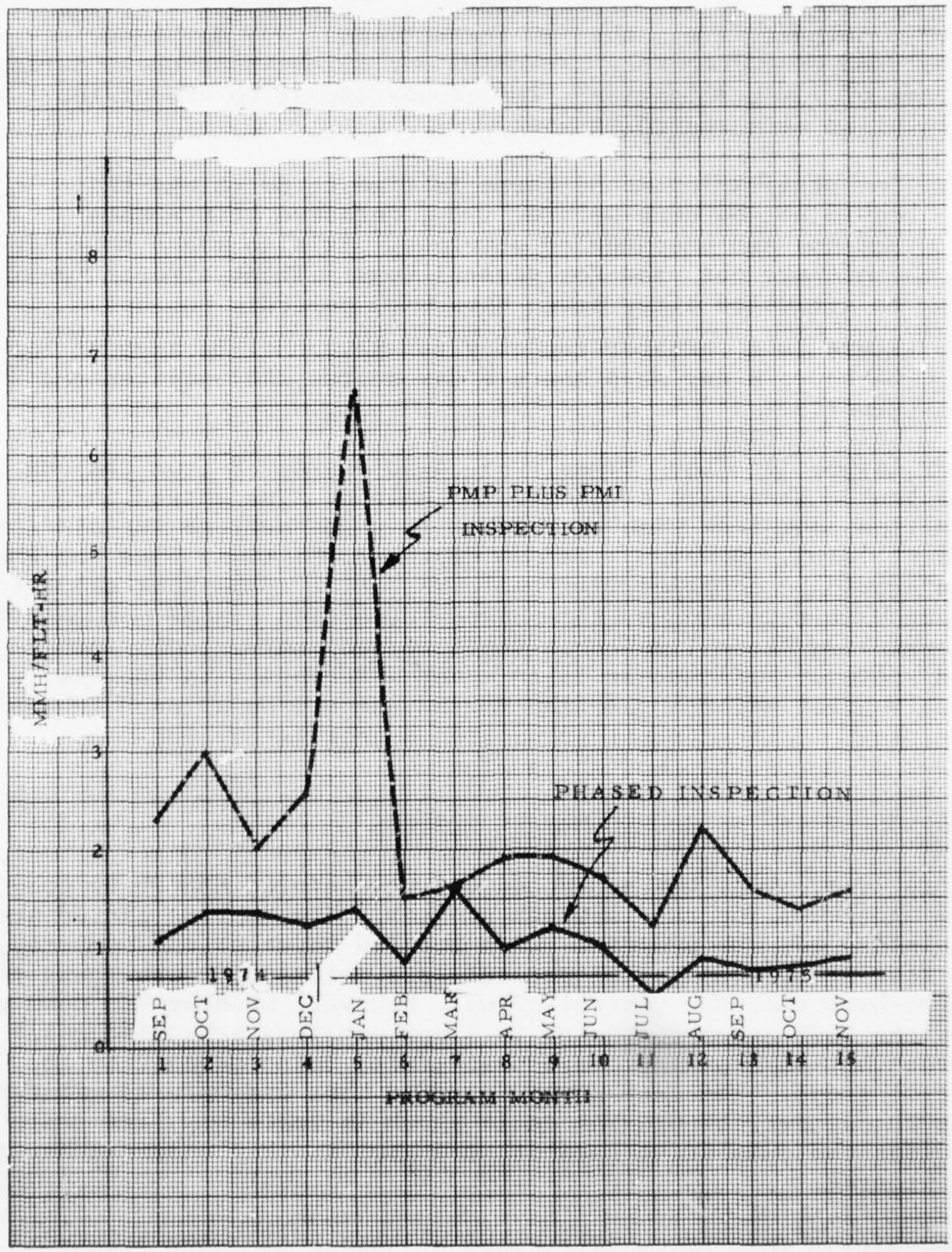


Figure 20. Monthly Comparison of Test and Control Group Major Inspections (MMH/FH).

period when the aircraft did not fly very much - a probable effect of the holiday season. Never-the-less, this same effect was noted elsewhere, i.e., the PMD inspections. Why do higher expenditures of maintenance man-hours per flight-hour occur during periods of low utilization? Two causes appear to affect low utilization data recording most.

1. Low utilization means there is time to do things that could not be done before, i.e., deferred maintenance actions and unscheduled services. It also means some aircraft are not used for several days. These aircraft must be activated after seven days with periodic run-ups.
2. There is a greater tendency for personnel to account for 24 hours a day or 8 hours a day on the 2407 maintenance reports.

Major inspection "Look Times" were also extracted from the DMS data bank. These are presented in Table 5. The phased inspection time took less time to perform than the average PMP did (36 percent less). However, the sum of three PMI times plus the PMP time should be compared with the phased time to be more accurate. Computed in this manner, the phased inspection system consumed 47 percent less "Look Time" than the intermediate/periodic inspection system. This number is in exact agreement with the previously given major inspection MMH/FH comparison as over the entire program; the control group flew approximately the same number of hours the test group flew.

UNSCHEDULED AND SCHEDULED MMH/FH RESULTS

Figure 19 presents the scheduled and unscheduled MMH/FH by company and group for the 15-month program. The numbers listed are cumulative for the program. When totaled together and compared, the test group consumed 13 percent less maintenance man-hours per flight-hour than the control group. However, when broken down we find the test group consuming 26.5 percent less scheduled maintenance but 45.2 percent more unscheduled maintenance than the control group. The test group consumed more unscheduled maintenance throughout the program as is shown in Table 6. This table provides the cumulative results, monthly, as they occurred during the program.

The question most frequently asked by personnel being briefed about Project Inspect is - "Why was unscheduled maintenance greater for the test group than it was for the control group?

TABLE 5. APPROXIMATE AVERAGE MAJOR INSPECTION TIMES.

	TEST		CONTROL		
MONTH	NO. FLIGHT-HOURS	AVG. PHASED INSPECTION TIME (HRS.)	NO. FLIGHT-HOURS	AVG. PMI TIME (HOURS)	AVG PMP TIME (HOURS)
1	1236	121	1362	18	170
2	1309	140	1304	11	266
3	1146	141	1311	13	167
4	782	120	931	13	223
5	344	159	256	9	537
6	1094	85	960	12	108
7	916	164	739	12	132
8	1654	97	1156	13	147
9	1276	119	1263	7	164
10	2079	100	1770	10	137
11	1613	53	1570	9	95
12	1543	91	1611	10	196
13	1255	76	1244	18	112
14	1541	84	1509	9	113
15	1693	91	1875	7	135
TOTALS	19481	102	18861	11.1	160

TABLE 6. PROJECT INSPECT CUMULATIVE MAINTENANCE RESULTS (MMH/FH).

	TEST GROUP			CONTROL GROUP		
MONTH	SCHEDULED	UNSCHEDULED	TOTAL	SCHEDULED	UNSCHEDULED	TOTAL
1	3.083	0.620	3.70	4.200	0.419	4.62
2	3.464	0.793	4.26	4.769	0.595	5.36
3	3.669	1.095	4.76	4.348	0.624	4.98
4	3.630	1.619	5.25	4.496	0.685	5.18
5	3.730	1.774	5.51	4.903	0.768	5.67
6	3.581	1.811	5.39	4.676	0.764	5.44
7	3.675	1.898	5.57	4.582	0.805	5.39
8	3.430	1.716	5.15	4.510	0.795	5.31
9	3.387	1.658	5.04	4.413	0.811	5.22
10	3.216	1.549	4.77	4.359	0.938	5.30
11	3.068	1.486	4.55	4.272	0.935	5.21
12	3.098	1.474	4.57	4.265	0.918	5.18
13	3.039	1.460	4.50	4.200	0.981	5.18
14	2.989	1.404	4.39	4.100	0.953	5.05
15	2.972	1.350	4.32	4.044	0.930	4.97

Analysis performed during early MAVIS model work and during Project Inspect Phase I indicated that unscheduled maintenance would be greater for the 100/800 hour phased inspection system used by the test companies than for the 25/100 hour system used by the control companies. In the 100/800 hour system, major inspection intervals are increased. If component failure rates are constant, increases in inspection intervals means that more failures can occur between the major inspections and therefore more unscheduled maintenance will be required. The extreme case of opening up of inspection intervals would be the on-condition maintenance situation in which no major inspections are scheduled. In that case maintenance is only performed when a condition requiring maintenance is perceived and, therefore, all maintenance actions are unscheduled actions.

DAILY INSPECTIONS - PMDs

The Data Management System also kept track of the daily inspection or PMD recorded times. Figure 19 and Table 4 provide the cumulative results for the program. (The final computer printout and tabular listing of each months cumulative results.) Note in both cases the cumulative test group PMD times are significantly greater than the control group PMD times. Why? This was one of the most frequently asked questions during the Phase II program. In order to begin to see the reason for it, the cumulative processing function must be removed from the data. This has been done and the result is shown in Figure 21. Figure 21 portrays the incremental or actual PMD maintenance man-hour per flight-hour ratio for each program month. The graph shows a great disparity existed during the first four months; a sharp peak occurred in January 1975; and then approximate tracking of the test and control groups resulted. The sharp peak was due to the holiday season, low-utilization period effect as explained on page 86. The large disparity between the test and control group during the early months was attributed to two factors: (1) Test company maintenance personnel were initially concerned about the safety aspects of the opened-up inspection intervals in the 100/800 system and, therefore, were more attentive to the PMD, and (2) Initially the PMD checklist in the test group was a specially prepared list with a 21 area breakdown to correspond with the 21 areas in the phased inspection checklist. This proved cumbersome and after a few months when crew chiefs realized that actual checklist content was unchanged from the standard PMD, it was effectively discarded.

The RCA field representative reported that a PMD normally takes 1.5 to 2.5 hours to perform. However, the data received indicated

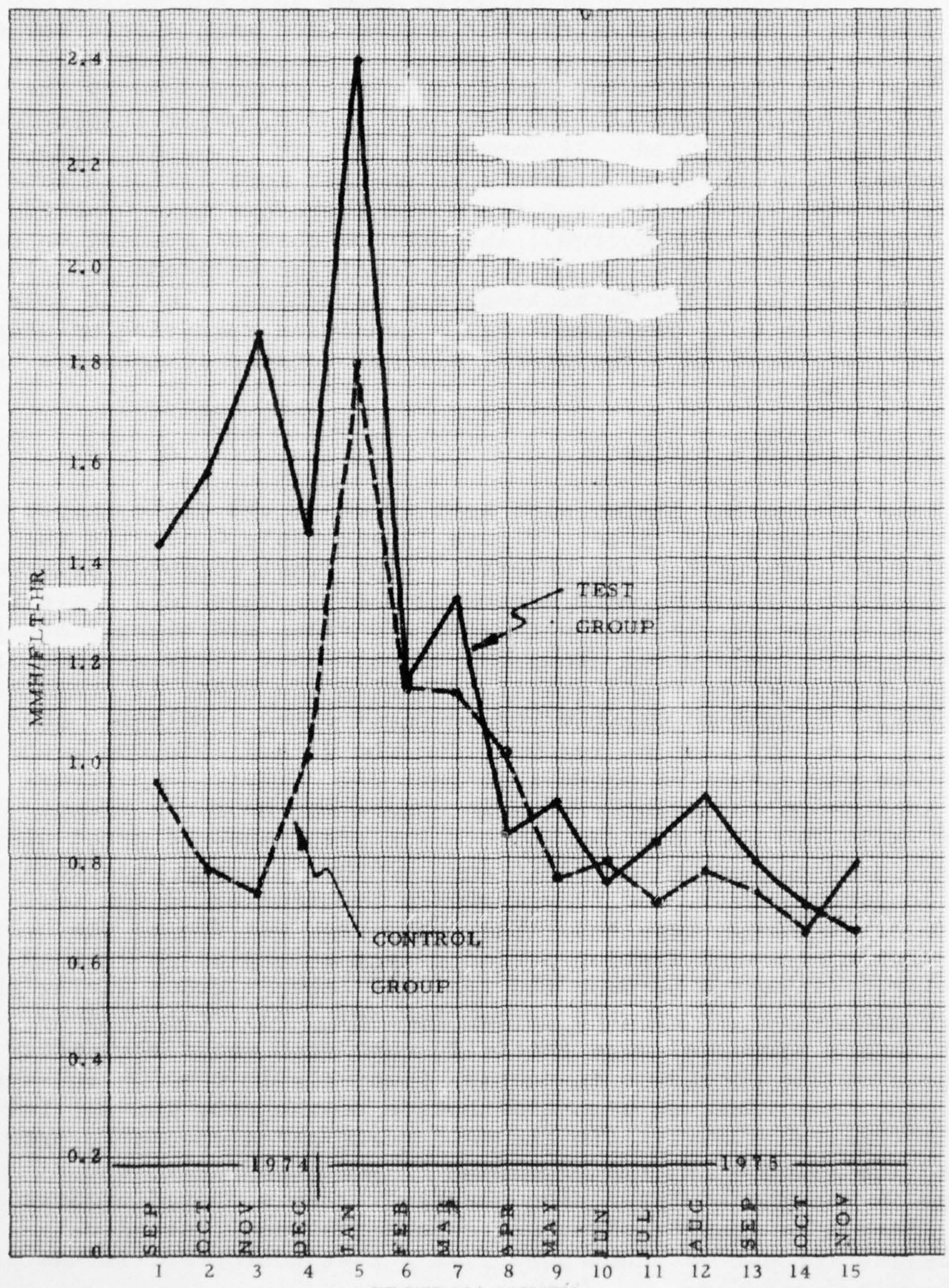


Figure 21. Group Daily Inspection Results (MMH/FH).

that many of the PMD inspections took from 4 to 8 hours long. The field investigation produced the following additional reasons:

1. Inconsistent data recording occurred, for example, some companies combined services (action codes 1 or 2) with the PMD (code 3), while others separated these actions.
2. There was a tendency to account for total available time during the day.
3. The experience level of the applicable crew chief and his knowledge of his assigned aircraft affected the time required to perform a PMD.
4. OJT occurred during some daily inspections; the man-hours for two people were then recorded rather than one.
5. The PMD time recorded included the total time to walk out to the aircraft, inspect the aircraft, and return to the hanger area (in some cases additional trips for tools were included).

The early PMD data recording discrepancies were reduced by close monitoring of the MMRs prior to submittal, scheduled data recording classes, and the issuance of the Project Inspect Data Recording Guide.

OPERATIONAL READINESS

Figure 17 presents the DMS processed results for Operational Readiness (OR) for the 15-month Phase II field evaluation program. OR is given in Figure 17 by company and by group in cumulative form. Table 7 presents the cumulative, results produced each month by the DMS. The changes of OR during the program were of considerable interest and several explanations were given on this variable. These explanations will be repeated below. First, however, the actual monthly incremental changes are better identified in Figure 22. It was expected that the test group OR would be slightly higher than the control group OR throughout the program. This did occur cumulatively as is illustrated by Table 7. However, the wide variations that actually occurred, as shown by Figure 22, were not anticipated. The deviations shown on the graph are best explained as the result of operational demands upon the 101st Airborne Division at Fort Campbell. Some of these demands are noted in the excerpts from several letter progress reports which follow. The dates refer to issue date of the letter progress report and not the date shown on Figure 22.

TABLE 7. PROJECT INSPECT CUMULATIVE A/C STATUS RESULTS (PERCENT).

MONTH	TEST GROUP OR	TEST GROUP NORS	TEST GROUP NORM	CONTROL GROUP OR	CONTROL GROUP NORS	CONTROL GROUP NORM
1	78.0	4.7	11.1	76.3	12.2	7.2
2	78.3	4.8	10.7	74.7	12.3	8.9
3	78.4	5.7	11.5	73.3	12.5	10.4
4	79.4	5.4	11.9	73.8	12.6	10.1
5	80.5	5.2	11.5	75.7	11.9	9.2
6	80.5	4.6	12.1	76.5	11.8	8.6
7	80.5	4.3	12.5	77.0	11.1	8.8
8	80.4	4.1	12.9	77.7	10.5	8.5
9	30.0	4.0	13.6	76.9	10.5	9.6
10	79.4	4.7	13.7	76.5	10.5	10.3
11	79.2	5.0	13.8	76.2	10.1	11.2
12	79.2	5.0	13.8	75.8	9.6	12.3
13	78.6	5.3	14.2	75.6	9.5	12.8
14	77.7	5.9	14.5	75.8	9.3	12.8
15	76.9	6.1	15.2	75.8	9.2	13.0

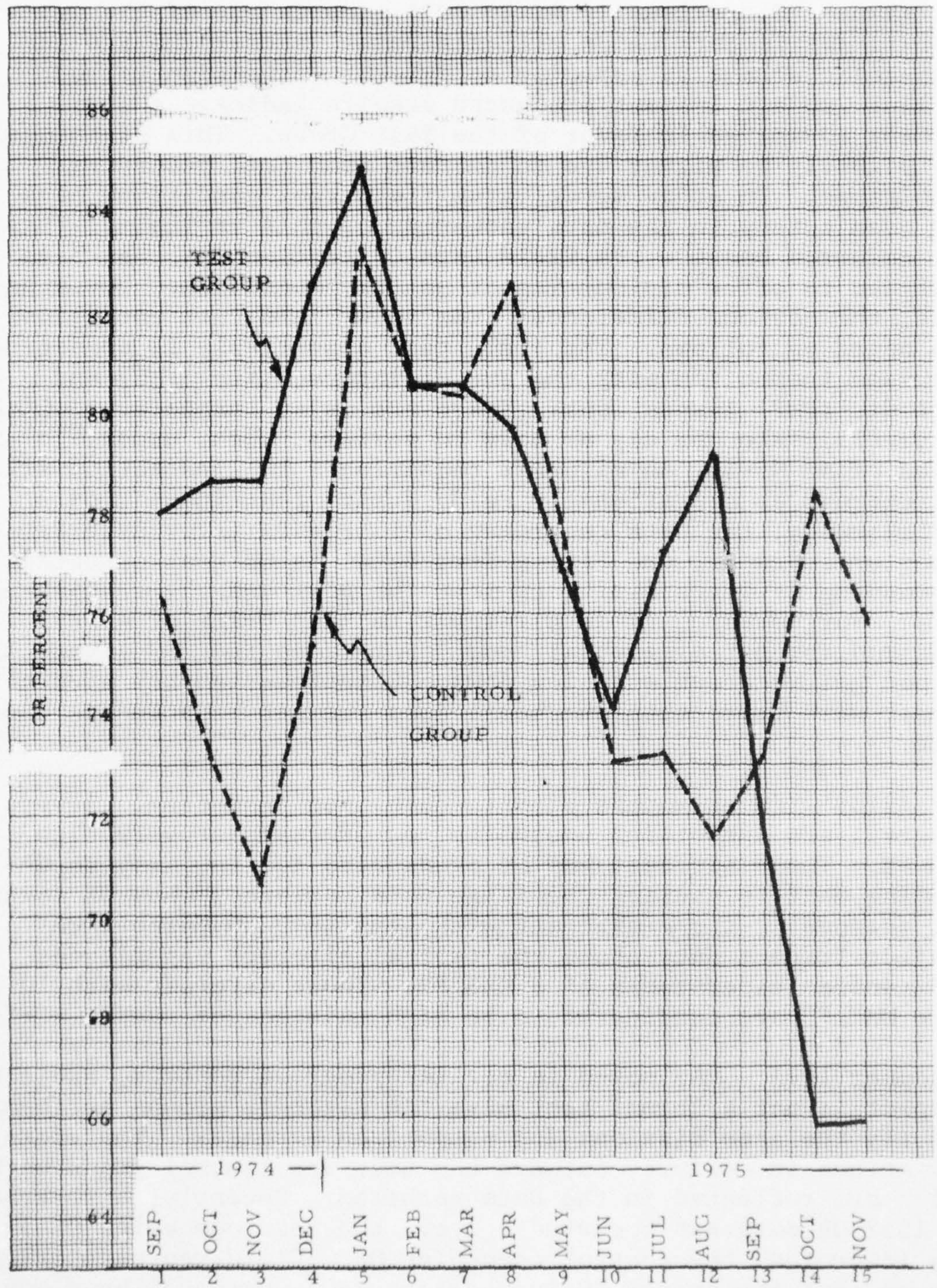


Figure 22. Group Monthly Operational Readiness Results.

May 1975: "Operationally Ready (OR) time is one of the key operational factors which will determine whether the Phased inspection scheme is superior to PMP-PMI inspection method. Current Project Inspect processed results indicate a 3.5 percent advantage in favor of the Test Group. This advantage may actually be higher due to current Army data recording conditions. In other words, true field test conditions have not been set-up in the data gathering of this variable. This has occurred because the Field Data Collection Plan has been designed to offer minimum impact on Army operation. Nevertheless, the obvious differences from true field test conditions are noted as follows. The field test essentially is comparing a phased inspection with the sum of intermediate (PMI) and periodic (PMP) inspections. These are major inspections which in general take one day or more to perform. Yet, under the rules of AR 95-33, an aircraft requiring a PMI inspection will be recorded as operationally ready during that inspection. Additionally, the data recording of 1352 data (Army Aircraft Inventory, Status, and Flying Time Data) is OR goal oriented. Commanding Officers strive to meet the goal and the troops know this. Furthermore, it is difficult to keep track of every downtime (or not available) hour. Sometimes red "X" aircraft do not get recorded as being down. Sometimes lengthy aircraft repair work (more than one hour) does not get recorded as downtime. - -".

May 1975: "Seven months of data have been processed. Several aircraft are exhibiting unusually low OR rates or very high MMH-FH. These aircraft may be candidates for the Army to determine what is causing the large data variance. Low OR rates are defined as those aircraft with less than 50 percent OR. Project Inspect data shows the typical aircraft experiences maintenance expeditures of 5 MMH/FH. Those aircraft with 10 or more MMH/FH are considered to be high maintenance users. - -".

December 1975: "As noted in earlier progress reports, Project Inspect is not a formal test with the aircraft groups performing exactly the same missions for comparison purposes. Therefore, deviations in activity between the test and control group occur which are reflected in the data gathered. Recently, a reversal in 1352 OR data has occurred - i.e., the test companies OR is now lower than the control companies OR. Field representatives report that the annual IG inspections kept personnel busy and prevented them from performing maintenance during the 14th month. During the 12th month, control companies had built up a large backlog of maintenance man-hours which resulted in a low OR.

However, this also caused a reduction in planned control company field exercises; therefore, by the 13th month control company OR had recovered to a higher level."

January 1976: "Data for the 15th month indicates the test group OR rate is less than the control group OR rate. Factors contributing to this low OR rate are higher than usual NORM and/or NORS as follows:

1. One test company utilized only 18 aircraft most of the period. Extensive DS or GS maintenance was performed. Organizational maintenance and NORS were also high. Although the company received the two aircraft replacements late in the period, they had to carry both aircraft for the entire period on the 1352 since they were the reporting company for the period. This increased the DS NORM.
2. The second test company had 12 aircraft entered into phase inspection. Most of these aircraft had to wait for good weather to perform the required test flight (six consecutive days of bad weather occurred). In addition, two aircraft had a total of 1259 hours DS on tail boom and cross tube maintenance. These factors caused a high NORM rate.
3. The third test company had satisfactory OR - 71 percent."

DOWNTIME DUE TO SUPPLY (NORS)

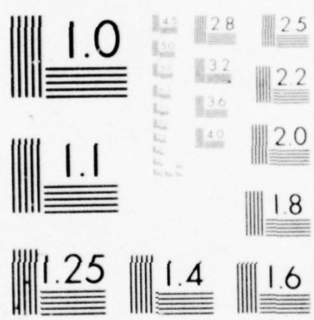
Figure 17 and Table 7 present the DMS cumulative monthly results for NORS. Cumulatively speaking, NORS was higher for the control group during the entire program. However, extraction of NORS data on a monthly incremental basis shows a wide data range for this variable. Figure 23 shows the wide differences NORS data gathering has produced. The first few months of the program provided an almost doubling of the NORS value of the control group over the test group. This was sufficient to influence the cumulative results to be higher for the control group shown in Table 7 for the entire program. During the early months of the program the question was asked - "Why are the test companies NORS rates lower than the control companies and their NORM rate higher than the control companies?" The answer given follows:

"When Project Inspect was initiated, a decision had to be made as to which companies would be test and which would be control. Captain Carey, the 101st Aviation Group AMO at that time, divided the companies evenly according to maintenance skill levels. It was determined after the test had been started that according to past

AD-A033 721 RCA GOVERNMENT AND COMMERCIAL SYSTEMS BURLINGTON MASS--ETC F/G 15/5
FIELD EVALUATION OF UH-1H HELICOPTER INSPECTION SYSTEMS. PROJEC--ETC(U)
NOV 76 F W HOHN, B B WIERENGA, J M BARDIS DAAJ02-74-C-0044

UNCLASSIFIED USAAMRDL-TR-76-27 NL

2 OF 3
AD
A033721



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

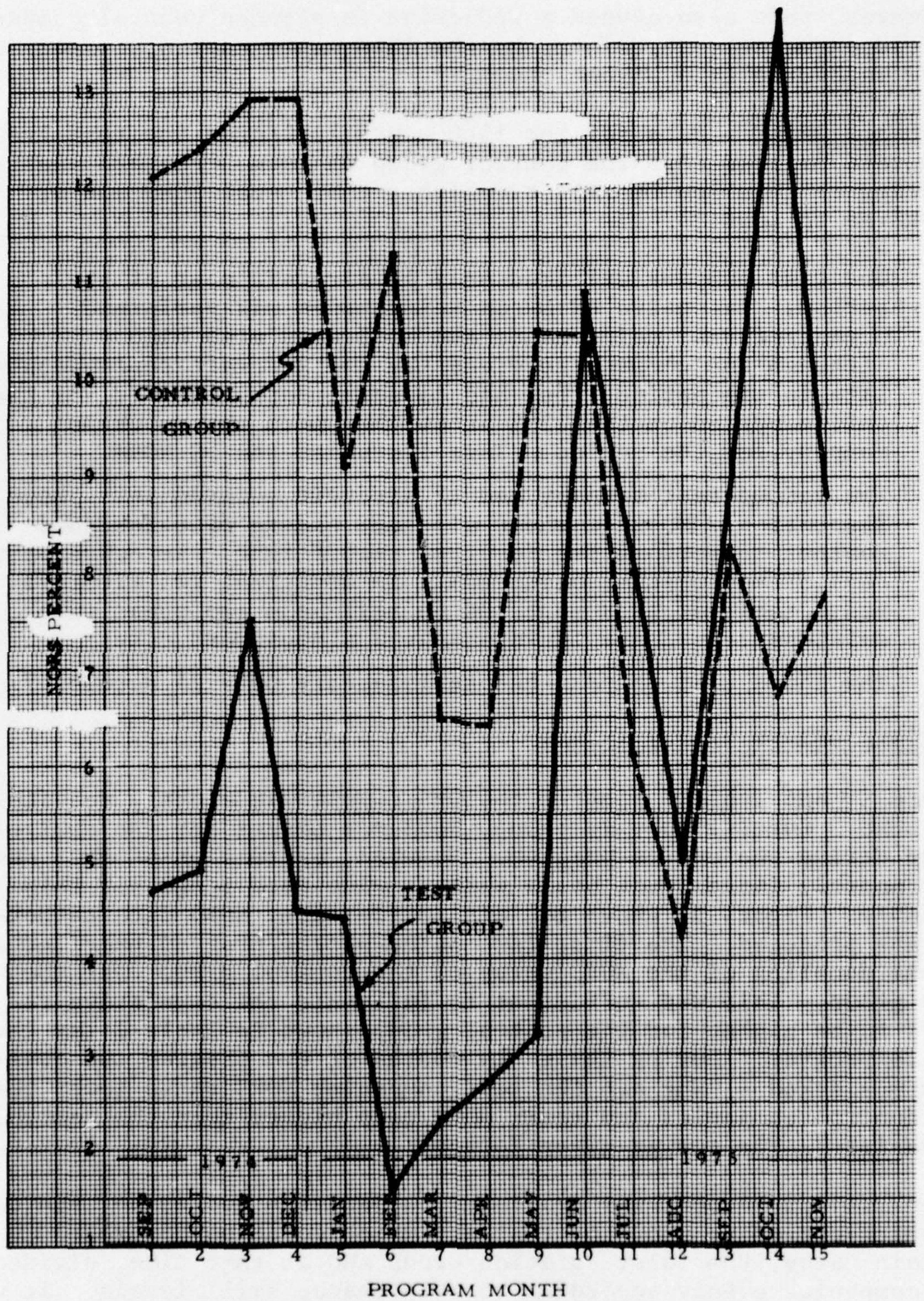


Figure 23. Group Monthly NORS Results.

"historical records these companies had demonstrated this same trend for at least 22 months of reporting prior to the start of the Project Inspect test.

"The consistent reporting of higher NORM by test companies and higher NORS by control companies was noted early in the test and has been discussed at several SAG meetings. Field office personnel have devoted serious effort to questioning Fort Campbell maintenance personnel in this area and pressing for more consistent reporting. These efforts have not influenced NORS/NORM reporting."

The RCA field representative also reported the following: NORS data is directly reported on DA Form 1352 and is influenced by several considerations, including:

1. Company policy
2. Availability problems with specific components
3. Funds availability
4. Flying hours recently accomplished (tends to affect the number of maintenance actions)
5. Aircraft age and logged number of flying hours
6. The number of operating and maintenance errors
7. Selection of NORM or NORS status for reporting aircraft downtime.

These considerations will vary from month to month depending on the conditions encountered. During a long field test such as Project Inspect Phase II, only items 1 and 7 above should remain fairly fixed as they depend on company procedures.

DOWNTIME DUE TO MAINTENANCE (NORM)

Figure 17 and Table 7 also present the DMS cumulative monthly results for NORM. Cumulatively speaking, NORM was higher for the test group during the entire program. However, extraction of NORM data on a monthly incremental basis shows some tracking for most of the program. Figure 24 presents the group monthly incremental results. The test group and control group lines cross each other at four points. The test groups higher NORM during months 1,4,5,6,7 and 8 was sufficient to produce higher test group cumulative results for the entire program. The comments given in the previous paragraph (NORS discussion) apply equally with the variable NORM. The reader is referred to the last four paragraphs of the previous subsection.

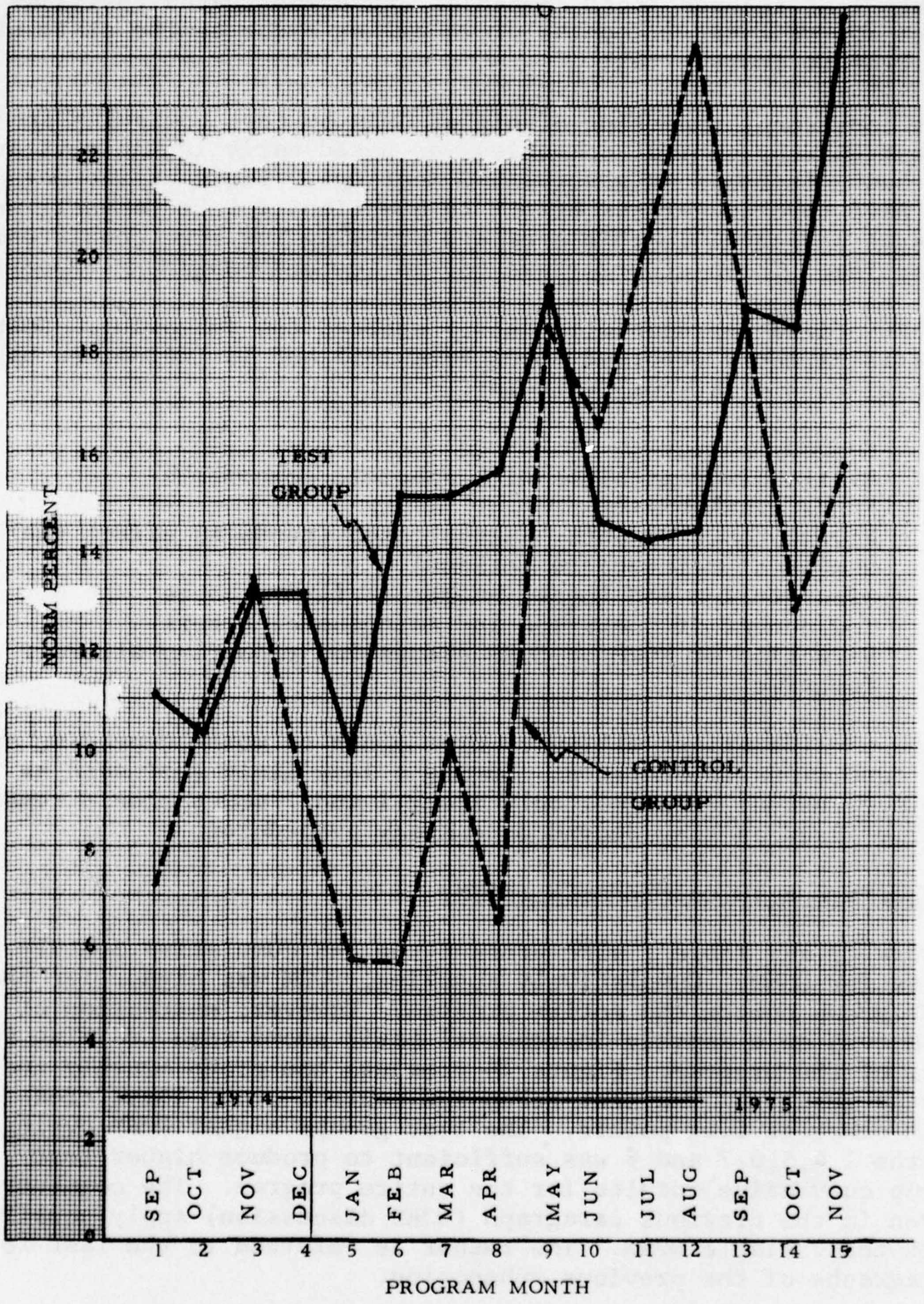


Figure 24. Group Monthly NORM Results.

RELIABILITY/SAFETY CRITICAL COMPONENTS

Figure 17 and Table 8 present the DMS cumulative monthly results for Mission Reliability. A slightly higher reliability result was produced by the control group. This evaluation variable was computed using the number of preflight aborts, in-flight aborts and the number of flights. Abort recording was newly instituted into the Army by Project Inspect. It is believed that the figures are so close that no significance can be shown by them. Thus, the two inspection schedules are equally effective in terms of mission reliability.

The DMS processing program also produced a critical component safety control listing each month. Ninety five* components were checked each month for failures and/or adjustments greater than historical computed limit values (computed based on the number of flight hours flown). Figure 25 is the final listing for the critical component safety control program. At the end of the program, 23 components were listed for both the test group and the control group. Of these, 14 components in the test group and 9 components in the control group exceeded the historical failure limit by more than 100 percent. Table 9 lists these components. A factor of 100 percent was arbitrarily chosen to compare the two groups as the failure numbers are known to be slightly high. The Project Inspect failure numbers (*TOTAL FAILED* on Figure 25) are high because they include maintenance adjustments as well as replacements. Note the exact agreement of the control group components on Table 9 with the test group components. Thus, similar components in both groups failed.

WHEN DISCOVERED CODE REPORTING RESULTS

Figure 26 presents a brief definition of the nine When Discovered Codes (WDC) and the total program summary quantity of maintenance actions reported. In general, it can be seen that the test group reported a greater number of maintenance actions than the control group. Why did this occur? This question and other questions explaining the differences between the test and control group WDC quantity results were addressed to the field office. The following lists the questions and answers given for WDC recording and the quantity results.

<u>Question 1</u>: Why has the test group reported more maintenance actions?

---

*UH-1H components based on TB55-1500-307-25, Aircraft Components Requiring Maintenance Management and Historical Data.

TABLE 8. PROJECT INSPECT CUMULATIVE RELIABILITY RESULTS.

MONTH	TEST GROUP MISSION RELIABILITY (%)	CONTROL GROUP MISSION RELIABILITY (%)
1	97.7	98.6
2	97.2	98.3
3	97.3	98.5
4	97.6	98.6
5	97.7	98.6
6	98.0	98.7
7	98.0	98.7
8	98.1	98.7
9	98.1	98.6
10	98.3	98.6
11	98.4	98.6
12	98.4	98.6
13	98.4	98.5
14	98.3	98.5
15	98.4	98.6

PROJECT INSPECT CRITICAL COMPONENT SAFETY CONTROL PROGRAM

PAGE 1
RUN DATE 76/01/22

TEST AND CONTROL GROUP COMPONENTS WHICH EXHIBIT A SAMPLE OF FAILURES GREATER THAN HISTORICAL STATISTICAL LIMITS

AND THUS SUGGEST FURTHER INVESTIGATION FOR THE POSSIBILITY OF POTENTIAL SAFETY PROBLEMS

FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR UH-1H TEST GROUP HELICOPTERS AT FORT CAMPBELL, KENTUCKY

GROUP WUC NAME	GOOD TOS	DET START/ TOS	FAILURE CODES =1 PCT	=2 PCT	=3 PCT	ABORTS WITH FR/ NO FR	(ABORTS INFLT MMH PER FAILURE	INT HRS / QUANT PER AC	MTBF/ TOTAL FAILED	= OF FAILURES DISCOVERED AT WDC POINTS 1/ 2	3/ 4	5/ 6	7/ 8	9	FAILURES SCHED/ UNSCHED	MMH SCHD/ UNSHD	TBO QUANT/ MMH
LIMIT 21 FAILURES																	
1 14128	Y	312	020	232	730	13.5	16.7	100	342	5	4	1	3	0	15	2.1	13
CYCLIC SWASH/SPT ASY		27	77	4	4	59.3	3.2	1.0	57	1	28	15	0		42	3.6	7.0
LIMIT 64 FAILURES																	
1 1412C	Y	387	020	232	673	1.8	0.0	100	278	1	8	1	2	0	17	0.8	0
SWASHPLATE TRUNNION		25	86	7	4	19.5	1.3	1.0	70	0	40	17	1		53	1.4	0.0
LIMIT 4 FAILURES																	
1 1412E	Y	106	020	979	231	7.5	99.9	100	974	0	1	0	1	0	9	2.7	0
SYNC ELEV CNTL LINKS		45	65	5	5	48.5	4.3	7.0	20	1	8	9	0		11	5.6	0.0
LIMIT 46 FAILURES																	
1 14138	Y	330	020	116	239	0.0	0.0	100	348	0	2	0	1	0	35	1.2	0
T R CNTRL CABLE ASSY		65	46	11	7	0.0	1.4	4.0	56	0	18	35	0		21	1.7	0.0
LIMIT 4 FAILURES																	
1 1511E	Y	205	190	381	790	0.0	0.0	100	513	0	6	3	0	0	11	0.9	0
M R POWER GRIP ASSY		29	29	26	13	0.0	1.9	2.0	38	0	13	11	5		27	2.3	0.0
LIMIT 93 FAILURES																	
1 15114	Y	570	790	717	190	10.4	87.5	100	197	1	0	25	14	0	24	1.7	4
M R BLADE ASSEMBLY		25	46	8	15	15.4	2.8	2.0	99	7	27	24	1		75	3.2	2.0
LIMIT 2 FAILURES																	
1 222A4	Y	15	790	374		0.0	0.0	200	6494	0	0	1	0	0	1	13.0	0
INTSTAGE AIR BLD ACT		67	67	33	0	0.0	14.3	1.0	3	0	1	1	0		2	15.0	0.0
LIMIT 2 FAILURES																	
1 222A5	Y	10	790	781		0.0	0.0	200	9741	0	0	1	0	0	1	1.0	0
INTSTAGE AIR BLD BND		100	50	50	0	0.0	1.0	1.0	2	0	0	1	0		1	1.0	0.0
LIMIT 1 FAILURES																	
1 22212	Y	21	743	135	070	0.0	0.0	100	4870	0	1	1	0	0	1	1.0	0
INLET GUIDE VANE		25	25	25	25	0.0	1.0	1.0	4	0	1	1	0		3	1.3	0.0

Figure 25. Critical Component Safety Control Program Listing (Page 1 of 6).

PROJECT INSPECT CRITICAL COMPONENT SAFETY CONTROL PROGRAM — PAGE 2 — RUN DATE 76/01/22

TEST AND CONTROL GROUP COMPONENTS WHICH EXHIBIT A SAMPLE OF FAILURES GREATER THAN HISTORICAL STATISTICAL LIMITS

AND THUS SUGGEST FURTHER INVESTIGATION FOR THE POSSIBILITY OF POTENTIAL SAFETY PROBLEMS

FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR UH-1H TEST GROUP HELICOPTERS AT FORT CAMPBELL, KENTUCKY

GROUP WUC NAME	GOOD TOS	DET START/ TOS	FAILURE CODES =1 PCT	=2 PCT	=3 PCT	ABORTS WITH FR/ NO FR	(ABORTS INFLT MMH PER FAILURE	INT HRS / QUANT PER AC	MTBF/ TOTAL FAILED	# OF FAILURES DISCOVERED AT WDC POINTS 1/ 2	3/ 4	5/ 6	7/ 8	9	FAILURES SCHED/ UNSCHED	MMH SCHD/ UNSHD	TBO QUANT/ MMH
LIMIT 1 FAILURES																	
1 22213	Y	21	170	381	020	0.0	0.0	100	4870	0	0	0	0	0	1	12.0	0
COMPRESSOR HOUSING		25	50	25	25	0.0	12.0	1.0	4	0	3	1	0		3	12.0	0.0
LIMIT 1 FAILURES																	
1 22214	Y	47	301	020	171	0.0	0.0	100	2165	0	1	1	0	0	5	32.3	0
COMPRES ROTOR BLADE		56	44	22	11	0.0	19.3	1.0	9	0	1	5	1		4	3.0	0.0
LIMIT 4 FAILURES																	
1 22221	Y	94	170	381	196	6.5	99.9	100	1082	0	2	2	2	1	3	11.0	0
COMBUST CHAMBER HSNG		17	33	22	11	16.6	5.1	1.0	18	1	7	2	1		15	4.0	0.0
LIMIT 1 FAILURES																	
1 22231	Y	57	170	070	722	0.0	0.0	100	1771	0	1	2	1	0	3	1.8	0
DIFFUSER		27	36	18	9	0.0	6.7	1.0	11	0	2	3	2		8	8.6	0.0
LIMIT 1 FAILURES																	
1 22233	Y	52	381	190	020	0.0	0.0	100	1948	0	1	3	0	0	3	17.5	0
2ND STG PWR TURB ROT		30	30	20	10	0.0	19.0	1.0	10	0	2	3	1		7	19.7	0.0
LIMIT 4 FAILURES																	
1 22255	Y	74	381	473	585	0.0	0.0	200	1392	0	2	2	0	0	3	2.2	0
ACESSY DRIVE GEARBOX		43	71	7	7	0.0	4.1	1.0	14	0	6	3	1		11	4.7	0.0
LIMIT 10 FAILURES																	
1 22282	Y	116	070	381	170	0.0	0.0	100	883	0	1	3	1	0	7	0.9	0
ENG CHIP DETECTOR		32	27	18	9	0.0	1.4	1.0	22	0	10	7	0		15	1.6	0.0
LIMIT 4 FAILURES																	
1 22283	Y	47	070	120	790	0.0	0.0	200	2165	0	1	1	0	0	2	1.3	0
EXHAUST THERMOCOUPLE		44	44	22	11	0.0	2.1	6.0	9	0	5	2	0		7	2.3	0.0
LIMIT 4 FAILURES																	
1 26214	Y	21	381	910	190	0.0	0.0	100	4870	0	0	0	0	0	1	8.0	0
MANIFOLD		25	25	25	25	0.0	3.0	1.0	4	0	3	1	0		3	1.3	0.0

Figure 25. Critical Component Safety Control Program Listing (Page 2 of 6).

PROJECT INSPECT CRITICAL COMPONENT SAFETY CONTROL PROGRAM

TEST AND CONTROL GROUP COMPONENTS WHICH EXHIBIT A SAMPLE OF FAILURES GREATER THAN HISTORICAL STATISTICAL LIMITS

AND THUS SUGGEST FURTHER INVESTIGATION FOR THE POSSIBILITY OF POTENTIAL SAFETY PROBLEMS

FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR UH-1H TEST GROUP HELICOPTERS AT FORT CAMPBELL, KENTUCKY

GROUP WUC NAME	GOOD TDS	DET START/ TDS	FAILURE CODES =1 PCT	=2 PCT	=3 PCT	ABORTS WITH FR/ NO FR	(ABORTS INFLT MMH PER FAILURE	INT HRS / QUANT PER AC	MTBF/ TOTAL FAILED	# OF FAILURES DISCOVERED AT WDC POINTS 1/ 2	3/ 4	5/ 6	7/ 8	9	FAILURES SCHED/ UNSCHED	MMH SCHD/ UNSHD	TBO QUANT/ MMH
LIMIT	3 FAILURES																
1 26247	Y	21	381	473	927	0.0	0.0	100	4870	0	1	0	0	0	1	1.0	0
MN XMISS OIL PUMP		25	25	25	25	0.0	1.5	1.0	4	0	2	1	0		3	1.7	0.0
LIMIT	10 FAILURES																
1 26414	Y	230	190	070	381	6.7	50.0	100	464	1	0	0	3	0	16	4.4	4
INT GEAR BOX		39	19	19	17	39.1	4.8	1.0	42	1	21	16	0		26	5.0	2.4
LIMIT	10 FAILURES																
1 26418	Y	295	381	020	473	9.5	25.0	100	361	3	3	4	2	0	14	4.0	0
T R QUILL ASSEMBLY		26	69	11	9	30.3	3.9	1.0	54	1	24	14	3		40	3.9	0.0
LIMIT	15 FAILURES																
1 2923E	Y	116	116	020	070	0.0	0.0	100	886	0	1	0	1	0	5	2.5	0
PARTICLE SEPARATOR		23	27	14	9	0.0	1.7	1.0	22	0	14	5	1		17	1.5	0.0
LIMIT	2 FAILURES																
1 41111	Y	10	108	196		0.0	0.0	100	9741	0	0	0	0	0	0	0.0	0
COMBUSTION HEATER		0	50	50	0	0.0	1.3	1.0	2	0	2	0	0		2	1.3	0.0
LIMIT	20 FAILURES																
2 14128	Y	270	020	031	374	0.0	0.0	100	393	0	9	1	2	0	13	5.5	18
CYCLIC SWASH/SPT ASY		27	83	4	2	0.0	3.1	1.0	48	0	23	13	0		35	2.2	10.5
LIMIT	4 FAILURES																
2 1412E	Y	128	020	790	705	0.0	0.0	100	820	0	2	0	0	0	14	5.0	0
SYNC ELEV CNTL LINKS		62	61	13	9	0.0	3.6	7.0	23	0	6	14	1		9	1.4	0.0
LIMIT	45 FAILURES																
2 1413E	Y	291	020	790	190	3.2	0.0	100	393	2	1	1	0	5	37	0.9	0
T R CNTRL CABLE ASSY		79	48	19	13	57.1	1.2	4.0	48	0	7	32	0		11	2.2	0.0
LIMIT	20 FAILURES																
2 14142	Y	190	381	116	374	21.4	80.0	100	555	1	0	4	0	0	13	2.6	0
FLT CNTRL IREV VALVE		39	59	15	12	53.5	2.9	4.0	34	4	12	13	0		21	3.0	0.0

Figure 25. Critical Component Safety Control Program Listing (Page 3 of 6).

PROJECT INSPECT CRITICAL COMPONENT SAFETY CONTROL PROGRAM

PAGE 4
RUN DATE 76/01/22

TEST AND CONTROL GROUP COMPONENTS WHICH EXHIBIT A SAMPLE OF FAILURES GREATER THAN HISTORICAL STATISTICAL LIMITS

AND THUS SUGGEST FURTHER INVESTIGATION FOR THE POSSIBILITY OF POTENTIAL SAFETY PROBLEMS

FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR UH-1H TEST GROUP HELICOPTERS AT FORT CAMPBELL, KENTUCKY

GROUP WUC NAME GOOD TOS	DET START/ TOS	FAILURE CODES =1 PCT	=2 PCT	=3 PCT	ABORTS WITH FR/ NO FR	(ABORTS INFLT MMH PER FAILURE	INT HRS / QUANT PER AC	MTBF/ TOTAL FAILED	= OF FAILURES DISCOVERED AT WDC CODES 1/ 2	3/ 4	5/ 6	7/ 8	9	FAILURES SCHED/ UNSCHED	MMH SCHD/ UNSHD	TBO QUANT/ MMH
LIMIT 4 FAILURES																
2 15118 Y	127	381	790	070	0.0	0.0	100	820	0	0	0	1	0	11	5.1	0
M R POWER GRIP ASSY	48	30	17	13	0.0	6.4	2.0	23	0	7	11	4		12	7.5	0.0
LIMIT 1 FAILURES																
2 22212 Y	5	513			0.0	0.0	100	18861	0	0	1	0	0	0	0.0	1
INLET GUIDE VANE	0	100	0	0	0.0	5.0	1.0	1	0	0	0	0		1	5.0	1.5
LIMIT 1 FAILURES																
2 22213 Y	11	070	790		0.0	0.0	100	9431	0	1	0	0	0	1	0.5	0
COMPRESSOR HOUSING	50	50	50	0	0.0	0.8	1.0	2	0	0	1	0		1	1.0	0.0
LIMIT 1 FAILURES																
2 22214 Y	49	301	910	170	0.0	0.0	100	2096	0	0	2	1	0	5	7.2	0
COMPRES ROTOR BLADE	56	56	11	11	0.0	20.2	1.0	9	0	1	5	0		4	36.3	0.0
LIMIT 4 FAILURES																
2 22221 Y	38	170	190	381	0.0	0.0	100	2694	0	0	0	1	0	4	3.8	0
COMBUST CHAMBER HSNG	57	43	29	14	0.0	8.3	1.0	7	0	1	4	1		3	14.3	0.0
LIMIT 1 FAILURES																
2 22231 Y	100	170	116	020	0.0	0.0	100	1048	0	0	0	0	0	15	1.6	0
DIFFUSER	84	67	11	6	0.0	2.5	1.0	18	0	3	15	0		3	7.1	0.0
LIMIT 1 FAILURES																
2 22233 Y	53	381	190	790	0.0	0.0	100	1386	0	0	2	2	0	2	14.3	0
2ND STG PWR TURB ROT	20	50	10	10	0.0	31.9	1.0	10	0	3	2	1		8	36.4	0.0
LIMIT 13 F ILURES																
2 22254 Y	70	381	374	315	'11.1	0.0	100	1451	1	1	2	0	1	5	5.3	0
OVRSPD GOV/TACHDRIVE	39	52	15	8	32.2	3.7	1.0	13	0	4	4	0		8	2.7	0.0
LIMIT 4 FAILURES																
2 22255 Y	128	381	473	020	0.0	0.0	100	820	0	1	0	2	1	12	4.3	4
ACESSY DRIVE GEARBOX	53	61	13	13	0.0	5.2	1.0	23	0	8	11	0		11	5.9	0.4

Figure 25. Critical Component Safety Control Program Listing (Page 4 of 6).

PROJECT INSPECT CRITICAL COMPONENT SAFETY CONTROL PROGRAM

PAGE 5
RUN DATE 76/01/22

TEST AND CONTROL GROUP COMPONENTS WHICH EXHIBIT A SAMPLE OF FAILURES GREATER THAN HISTORICAL STATISTICAL LIMITS

AND THUS SUGGEST FURTHER INVESTIGATION FOR THE POSSIBILITY OF POTENTIAL SAFETY PROBLEMS

FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR UH-1H TEST GROUP HELICOPTERS AT FORT CAMPBELL, KENTUCKY

GROUP WUC NAME	GOOD TOS	DET START/ TOS	FAILURE CODES =1 PCT	=2 PCT	=3 PCT	ABORTS WITH FR/ NO FR	(ABORTS INFLT MMH PER FAILURE	INT HRS / QUANT PER AC	MTBF/ TOTAL FAILED	# OF FAILURES DISCOVERED AT WDC POINTS 1/ 2	3/ 4	5/ 6	7/ 8	9	FAILURES SCHED/ UNSCHED	MMH SCHD/ UNSHD	TBO QUANT/ MMH
LIMIT 7 FAILURES																	
2 22264	Y	38	190	070	730	27.5	0.0	100	2694	1	0	1	0	2	4	0.9	0
FUEL TUBE		57	29	29	14	44.9	1.8	3.0	7	0	1	2	0		3	3.0	0.0
LIMIT 4 FAILURES																	
2 22276	Y	27	120	116	070	0.0	0.0	100	3772	0	0	0	1	0	2	2.5	0
OIL TUBES		40	40	20	20	0.0	2.6	5.0	5	0	2	2	0		3	2.7	0.0
LIMIT 4 FAILURES																	
2 22281	Y	27	070	950	350	0.0	0.0	100	3772	0	0	1	0	0	0	0.0	0
SPEC PURPOSE CABLE		0	60	20	20	0.0	3.8	1.0	5	0	2	0	2		5	3.8	0.0
LIMIT 10 FAILURES																	
2 22282	Y	94	070	730	108	13.2	0.0	100	1109	1	1	1	0	6	13	1.0	0
ENG CHIP DETECTOR		77	47	24	12	38.9	0.9	1.0	17	0	1	7	0		4	0.5	0.0
LIMIT 4 FAILURES																	
2 26214	Y	38	381	070	473	0.0	0.0	100	2694	0	0	0	0	1	3	0.5	4
MANIFOLD		43	29	14	14	0.0	1.3	1.0	7	0	4	2	0		4	1.9	0.6
LIMIT 3 FAILURES																	
2 26215	Y	16	790	070	180	0.0	0.0	100	6287	0	0	0	0	0	2	2.8	0
COUPLING		67	33	33	33	0.0	2.5	1.0	3	0	1	2	0		1	2.0	0.0
LIMIT 4 FAILURES																	
2 26223	Y	21	374	070		0.0	0.0	100	4715	0	0	2	0	0	1	2.0	0
TEMPERATURE BULB		25	75	25	0	0.0	1.5	1.0	4	0	1	1	0		3	1.3	0.0
LIMIT 10 FAILURES																	
2 26414	Y	188	070	190	381	3.9	0.0	100	555	1	1	2	2	2	10	0.9	4
INT GEAR BOX		30	29	24	21	16.4	1.9	1.0	34	0	17	8	1		24	2.3	3.6
LIMIT 10 FAILURES																	
2 26418	Y	362	381	116	473	2.4	0.0	100	309	1	1	4	2	2	25	4.9	6
T R QUILL ASSEMBLY		42	69	10	10	13.9	4.3	1.0	61	0	28	23	0		36	3.8	0.9

Figure 25. Critical Component Safety Control Program Listing (Page 5 of 6).

PROJECT INSPECT CRITICAL COMPONENT SAFETY CONTROL PROGRAM

PAGE 6
RUN DATE 76/01/22

TEST AND CONTROL GROUP COMPONENTS WHICH EXHIBIT A SAMPLE OF FAILURES GREATER THAN HISTORICAL STATISTICAL LIMITS

AND THUS SUGGEST FURTHER INVESTIGATION FOR THE POSSIBILITY OF POTENTIAL SAFETY PROBLEMS

FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR UH-1H TEST GROUP HELICOPTERS AT FORT CAMPBELL, KENTUCKY

GROUP WUC NAME	GOOD TOS	DET START/ TOS	FAILURE CODES =1 PCT	=2 PCT	=3 PCT	ABORTS WITH FR/ NO FR	(ABORTS INFLT MMH PER FAILURE	INT HRS / QUANT PER AC	MTBF/ TOTAL FAILED	# OF FAILURES DISCOVERED AT WDC POINTS 1/ 2	3/ 4	5/ 6	7/ 8	9	FAILURES SCHED/ UNSCHED	MMH SCHD/ UNSHD	TBO QUANT/ MMH
LIMIT 2 FAILURES																	
2 41111 COMBUSTION HEATER	Y	11 0	020 50	109 50	 0	0.0 0.0	0.0 1.8	100 1.0	9431 2	0 0	1 1	0 0	0 0	0	0 2	0.0 1.8	0 0.0

Figure 25. Critical Component Safety Control Program Listing (Page 6 of 6).

TABLE 9. CRITICAL COMPONENTS EXCEEDING HISTORICAL FAILURE RATE BY 100 PERCENT.

TEST GROUP		CONTROL GROUP	
1.	CYCLIC SWASH/SPT ASSEMBLY	1.	CYCLIC SWASHPLATE/SPT ASSEMBLY
2.	SYNC ELEV CONTROL LINKS	2.	SYNC ELEV CONTROL LINKS
3.	MR POWER GRIP ASSEMBLY	3.	MR POWER GRIP ASSEMBLY
4.	INLET GUIDE VANE	-	————
5.	COMPRESSOR HOUSING	-	————
6.	COMPRESSOR ROTOR BLADE	4.	COMPRESSOR ROTOR BLADE
7.	COMBUST CHAMBER HOUSING	-	————
8.	DIFFUSER	5.	DIFFUSER
9.	SECOND-STG PWR TURBINE ROTOR	6.	SECOND-STAGE POWER TURBINE ROTOR
10.	ACCESSORY DRIVE GEARBOX	7.	ACCESSORY DRIVE GEARBOX
11.	ENGINE CHIP DETECTOR	-	————
12.	EXHAUST THERMOCOUPLE	-	————
13.	INTERMEDIATE GEARBOX	8.	INTERMEDIATE GEARBOX
14.	T.R. QUILL ASSEMBLY	9.	T.R. QUILL ASSEMBLY

QUANTITY OF ACTIONS FOUND BY WHEN DISCOVERED CODE CATEGORIZED BY GROUP AND COMPANY PAGE 45

RESULTS FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR UH-1H HELICOPTERS AT FORT CAMPBELL, KENTUCKY

QUANTITY IS THE NUMBER OF MAINTENANCE ACTIONS PERFORMED

WHEN DISCOVERED CODE	TEST GROUP COMPANIES B-CO 101ST	D-CO 101ST	D-CO 158TH	TEST GROUP SUMMARY	CONTROL GROUP COMPANIES C-CO 101ST	B-CO 158TH	C-CO 158TH	CONTROL GROUP SUMMARY
1	87	17	26	130	42	32	44	118
2	82	64	51	197	19	45	43	107
3	391	103	240	734	222	135	38	395
4	3252	1614	3230	8096	1109	1908	3016	6033
5	1521	1307	804	3632	521	352	179	1052
6	1122	694	1589	3405	877	1429	1341	3647
7	449	261	200	910	148	253	189	590
8	853	382	392	1627	152	244	283	679
9	4	4	1	9	432	533	354	1319

WHEN DISCOVERED CODES

1 MISSION ABORT-BEFORE FLIGHT
2 IN-FLIGHT ABORT
3 PRE-FLIGHT/FLIGHT READINESS INSPECTION(FLIGHT CREW)
4 DAILY INSPECTION (PMD)/AFTER FLIGHT/BETWEEN FLIGHTS
5 TEST FLIGHT/MOC/IN-FLIGHT(NO ABORT)
6 PMP/PHASED INSPECTION
7 SPECIAL INSPECTIONS
8 ALL OTHER
9 PMI INSPECTION

Figure 26. WDC Summary Quantity Results.

Answer: During the first five months of the program the test group was more highly motivated than the control group. As a result they:

1. Initially recorded a greater quantity of data
2. Had a greater number of experienced personnel
3. Maintained great stability of their personnel (were able to keep their experienced personnel)
4. Flew more hours
5. Used less DS personnel to accomplish their maintenance tasks. (DS personnel initially were poor data recorders - particularly on the MMR, as their prime data working/ recording document was the 2407 Work Order.)

Question 2: Why did the test group find a much larger quantity of maintenance needs during test flights than the control group?

Answer: Maintenance requirements were found more often by the test group for many of the same reasons expressed in the answer to question 1. During the early months of the program the control group did not tend to indicate that a test flight was performed when it was done. This forced the data recorder to indicate another time for discovery of a maintenance requirement. In addition, some of the test companies had the policy of stressing test flights with the initiation of a new and untried inspection system.

Question 3: Why the difference in WDC code 3 recording?

Answer: The test group total was higher primarily because the test companies scheduled a higher number "Nap-of-the-Earth" missions. These missions include critical flight maneuvers where the avionic instruments are of great importance. Thus, many of the maintenance actions detected by the flight crew were related to the avionic instruments. In addition, avionic work is generally "work ordered" to DS personnel. These work orders created additional action WDC quantities.

Question 4: Why the difference in WDC code 4 recording?

Answer: The test group recorded a greater quantity of WDC code 4s due to their:

1. Greater thoroughness in performing a PMD
2. Higher RMC condition
3. Higher number of avionic failures
4. Greater flying hour accomplishment - therefore a higher number of PMDs were performed
5. Higher average age of their aircraft.

Question 5: Why was WDC 7 higher in the test group?

Answer: Initially there was a recording misunderstanding of the use of WDC 7. This code was not adequately explained in the data collection plan. Initially, the test group used WDC 7 instead of WDC 8 for scheduled 25 hour services.

Question 6: Why was WDC 8 higher in the test group?

Answer: WDC code 8 was used by the test group for former PMI service actions.

Question 7: Why was WDC code 9 used almost exclusively by the control group?

Answer: Only the control companies performed the PMI inspection. The phased inspection system eliminated the formal 25-hour inspection.

Since WDC codes 7 and 8 were sometimes used incorrectly during the initial months of the program, a good check to determine if the data recording was balanced is to add together WDC codes 7, 8 and 9 for both groups. (WDC code 9 must be added in the sum for the control group to account for some 25 hour services and special inspections on the test group side.) If we do this, we find relatively close agreement in the quantity of maintenance actions performed by the two groups.

SPARES USAGE

Summary spares usage for the entire program is presented in Figure 27, while Table 10 lists the cumulative spares usage results on a monthly basis. Generally, the spares usage by the control group has been higher than the test group. (Tabulated in the use of components costing $200 or more.) However, this was not always true as is shown by months 8 and 9. This swing brought several questions and analyses during the program; they are repeated below.

PAGE 56

PROJECT INSPECT SPARE COMPONENT UTILIZATION AND TIME CHANGE REPLACEMENTS

FOR COMPONENTS THAT WERE REPLACED AND HAD A DOLLAR COST GREATER THAN OR EQUAL TO $200

FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR UH-1H HELICOPTERS AT FORT CAMPBELL, KENTUCKY

	TOTAL QUANTITY REPLACED	TOTAL $ COST	NUMBER OF TIME CHANGES	TOTAL TIME CHANGE $ COST
TEST GROUP COMPANIES				
B-COMPANY; 101 ST AVN BN - TEST GROUP	171	644619	26	44229
D-COMPANY; 101 ST AVN BN - TEST GROUP	159	496348	15	30436
D-COMPANY; 158 TH AVN BN - TEST GROUP	269	1041430	33	62860
CONTROL GROUP COMPANIES				
C-COMPANY; 101 ST AVN BN - CONTROL GROUP	168	963565	24	32466
B-COMPANY; 158 TH AVN BN - CONTROL GROUP	186	1479370	24	65550
C-COMPANY; 158 TH AVN BN - CONTROL GROUP	195	682360	25	41816
TEST GROUP TOTAL	599	2182397	74	137525
CONTROL GROUP TOTAL	549	3125295	73	139832

Figure 27. Spares Component Utilization Summary Results.

TABLE 10. PROJECT INSPECT CUMULATIVE SPARES COST RESULTS.

	TEST GROUP			CONTROL GROUP		
MONTH	FLYING HOURS (BY MONTH)	AVERAGE UTILIZATION	SPARES COSTS (K$)	FLYING HOURS (BY MONTH)	AVERAGE UTILIZATION	SPARES COSTS (K$)
1	1236	20.6	200.0	1362	22.7	133.3
2	1309	21.2	235.4	1304	22.2	504.7
3	1146	20.5	352.1	1311	22.1	621.8
4	782	18.6	512.5	931	20.4	750.8
5	344	16.0	570.1	256	17.2	783.8
6	1094	16.4	640.4	960	17.0	911.4
7	916	16.3	873.8	739	16.3	1035.5
8	1654	17.7	1210.8	1156	16.7	1067.6
9	1276	18.1	1350.7	1263	17.2	1122.1
10	2079	19.7	1484.9	1770	18.4	1927.2
11	1613	20.4	1528.5	1570	19.1	2457.7
12	1543	20.8	1757.0	1611	19.8	2686.9
13	1255	20.8	1798.5	1244	19.8	2822.7
14	1541	21.2	2026.0	1509	20.2	3051.9
15	1693	21.6	2182.4	1875	21.0	3125.3

July 1975: "The comparative magnitude of the "Total $ cost" variable printed on the Project Inspect Spares Component Utilization Summary has less significance than was originally expected. Possible bias exists in these numbers due to U.S. Army data collection procedures and assumptions made in computing the dollar values. Three influences known to affect the accuracy of this data are:

1. Common hardware and low dollar value component usage.
2. Engine replacements and repairs.
3. Aircraft replacements.

These items are discussed in the paragraphs below".

Common Hardware and Low Dollar Value Component Usage (July 1975)

"Common hardware such as nuts, bolts, fasteners, "O" rings, etc. are not reported by the Army as part of the MMR recording process. In addition, the data management system ignores parts reported with dollar values less than $200 from the spares usage processing. One possible impact of the Project Inspect program is the reduction of maintenance induced failures and over-inspection. Usage of common hardware and small parts is an area where such an effect will very likely be noted. Limited Project Inspect resources precluded the recovery of this kind of information from the field. The RCA field representative has recently analyzed NORS items for both the test and control companies for the period 20 September 1974 through 20 May 1975. These items were taken directly from the 1352 forms submitted by the six companies. Items listed have caused an aircraft NORS condition for at least 100 hours or more (approximately four days). To see what the difference in small parts "out-of-stockage" cases were, the TBO items and items with a dollar value greater than $200 were removed. Using this method the quantity of test company NOR items were found to total 20 items while the control company totaled 94 items. The greater NORS condition on the part of the control companies can be attributed in part to the differences between phased and intermediate/periodic inspection systems. The control companies are opening up covers and removing parts more often for inspection purposes. This has apparently resulted in greater common hardware and small parts usage by control group personnel. This spares usage difference is not reflected in the spares usage computer listings."

Engine Replacements/Repairs (July 1975)

"The engine is the most expensive component carried on the Project Inspect spares utilization computer listing ($95,200). Whenever an engine is replaced the full spares dollars are charged to that aircraft. This dollar value is so large that a couple of engines can easily swing the high total dollar cost magnitude from control group to test group and vice versa. The Fort Campbell field office does not have the manpower or the capability to track engines through DS, GS and Depot. Under the current record scheme, an engine can be removed and be replaced with one from the maintenance float. That same engine could be tested by GS, adjusted, and placed back into the float. However, the actions are not tracked and the data management system charges the total new engine replacement costs against that aircraft. Another case is modular repairs made to the engine by DS or GS. Again, full cost is charged against that aircraft. High time-consuming engine repairs are usually performed by the depot. A partial overhaul or major module replacement must cost less than the full cost of a new engine. Thus, engine spares utilization costs are probably overstated and can affect the Project Inspect Spares Component Utilization listings in an irregular manner."

Aircraft Replacements (July 1975)

"The six Project Inspect companies at Fort Campbell have defined missions which require twenty (20) operational aircraft. This number of aircraft is always reported on the 1352 form. Should one of the 20 aircraft in a company suffer major damage or be transferred, it is replaced from a float pool. Under Army regulations, all records go with the aircraft whether it be overhauled, transferred, investigated by an accident team or repaired by GS/Depot. MMR data gathered in Project Inspect is lost whenever an aircraft is removed from the organizational company's responsibility. The peculiarities of the status report system (1352 are such that an aircraft could be flown for 25-30 days in a PI company, maintained for that period of time and then transferred. All the component failures, flying hours, and maintenance man-hours associated with that 25-30 days are then lost to the Project Inspect data bank. Aircraft replacement since the beginning of the field test has occurred approximately 22 times. The loss of this data affects spares usage data and other computer processed Project Inspect data reports to some degree."

September 1975: "Why has the cost for items over $200 been higher for control companies when test companies have used more of these items?"

"The RCA Monthly Letter Report of July 1975 provides a lengthy discussion of spares usage dollar value computations which should be referenced. That discussion notes that the dollar value of an engine is so large ($95,200 or $77,770) that a couple of engines can easily swing the higher total dollar cost magnitude from control group to test group and vice versa. To date (20 June 1975), the reported data shows 11 engines have been replaced by the test group and 16 by the control group. Subtracting the dollar entries for these engines provides the following:

	Total Quantity Replaced	Total Dollar Cost	Average Dollar Cost
Test Group	383	$455,155	$1,188
Control Group	320	$438,902	$1,372

"The differences in these numbers are believed to be caused by the varying states of aircraft age, stress, TBO condition and the operational environment that Project Inspect is operating in."

December 1975: Components with High MMH -- "A look at all the MMH reported in the first 13 months led to the question - Which components are consuming the greatest number of man-hours for maintenance? During the period 31,724 flying hours were accumulated by the aircraft in the six Project Inspect companies. The total MMH expended was 153,282 hours. The following components with their respective WUC identification were found to be the high users:"

	COMPONENT	WUC CODES	NO ACTIONS (FAILURES+ REPAIRS+TBOs)	TOTAL MMH
1.	Turbine Engine	22000-22233	139	2657
2.	Aft Fuselage Skin/Structure	1116A-B + 11161-11163 + 11168	178	1862
3.	Main Starting Fuel System	22261 - 22266	579 (515 filters)	1553
4.	Main Rotor Hub	15115	139	1458
5.	Stabilizer Bar Assembly	1511	247	1278

	COMPONENT	WUC CODES	NO. ACTIONS (FAILURES+ REPAIRS+TBOs)	TOTAL MMH
6.	Cyclic Swashplate Trunnion & Support	1412B-C	187	629
7.	Main Rotor Blade	15114	176	615
8.	Main Fuel Filter	46115	395 (375 TBOs)	570
9.	Crew Door	11132 - 11136	348	491
10.	Main Drive Shaft	26111	116	432

Spares Usage - Final Corrected Results

The computer processed spares usage results given on Figure 27 include a bias caused by the inclusion of a very high dollar data item, the engine. This bias was noted and explained in the previous paragraph entitled "Engine Replacements/Repairs". To eliminate this bias, all engines were removed from the Figure 27 listing data of components costing $200 or more. This data is presented on Figure 28 in a similar format noting the quantity of engines involved. It is clear from this listing that the control companies consumed a higher dollar value of spares than the test companies did. On a group basis, the test companies consumed 11 percent more spares by quantity but spent $181,298 less than the control companies did. The money difference may be viewed as money saved, probably at least partially due to the implementation of the new major inspection system.

	Total Quantity Replaced (Engines not included)	Total $ Cost	Quantity Engines Removed/Replaced
TEST GROUP COMPANIES			
B-COMPANY: 101 ST AVN BN - TEST GROUP	166	186,049	5
D-COMPANY: 101 ST AVN BN - TEST GROUP	156	210,748	3
D-COMPANY: 158 TH AVN BN - TEST GROUP	260	202,060	9
CONTROL GROUP COMPANIES			
C-COMPANY: 101 ST AVN BN - CONTROL GROUP	161	297,165	7
B-COMPANY: 158 TH AVN BN - CONTROL GROUP	173	259,200	13
C-COMPANY: 158 TH AVN BN - CONTROL GROUP	190	223,790	5
TEST GROUP TOTAL	582	598,857	17
CONTROL GROUP TOTAL	524	780,155	25

Figure 28. Corrected Spares Usage Results (Engines deleted).

MAVIS MODEL REFINEMENT AND VALIDATION

The refinement of the MAVIS Model was required to improve its operating efficiency. Test computer runs of the model were also made using reduced field data as it accumulated into a viable sample size. These test runs were performed to evaluate the effect of the refinements and to validate the ability of the MAVIS to predict the relative merit of the competing inspection concepts. All validation computer runs were made using the IBM 360/65 computer at the U.S. Army Aviation Systems Command, St. Louis, Missouri. These runs provided on-the-job training to Government analysts and verified the proper function of the program on that computer.

MAVIS MODEL REFINEMENT

The basic goal of this part of the program was to refine the data input mechanism of the model to allow its use by maintenance analysts and programmers who are unfamiliar with its internal construction. This involved simplification of input data tables and bypassing of simple data errors with provision of error notification messages.

The input data tables were simplified by combining two of them into one. The Aircraft Configuration File was combined with the Component Mix input data table, thus eliminating the redundant code information and lessening the chance for input data errors. This modification reduced the number of input tables from three to two, the new Aircraft Configuration - Component Mix File and the Master Configuration File. An additional change was made to provide for automatic sorting of the Aircraft Configuration - Component Mix File and the Master Configuration File as they are input to the computer. This eliminates problems resulting from data being input out of sequence, which often occurs under the old model configuration.

Provisions to allow the model to run to completion with errors present in the input files were added. Runs are now completed as long as the number of input data errors does not exceed a specified value which is controlled by the analyst. In addition, error messages are provided which identify missing input data cards and cases where Master Configuration File entries are not

used. The following headings with data, if any, are now printed each time the model is run:

- A total of - errors were detected in the ACF file.
- Listed below are any MCF numbers not referenced.

These error message are printed after the A Option is printed.

The refined model is completely documented in the User's Manual delivered under Contract Data Item A009. (Reference 2.)*

MAVIS MODEL VALIDATION

For validation purposes, the MAVIS Model was run using data files that reflected increasing dependence upon field data as the data sample size increased. Runs were made at the conclusion of the 6, 12 and 15 month points of the field evaluation.

At the 6-month point, the number of flying hours accumulated was low (12,035 hours total or 33.4 percent of the program goal). There was little confidence in the failure data computations for the field data at that point. A Master Configuration File very close to that utilized in Project Inspect Phase I was therefore used. The first set of runs served basically as verification of the compatibility of the program with the AVSCOM computer and proof of the effectiveness of the model refinements discussed in the previous paragraphs.

At the time of the 12 month validation runs, 29,225 flying hours or 81.2 percent of the goal had been achieved. The Master Configuration File from Project Inspect Phase I was therefore updated to reflect heavy dependence upon the field data. Significant results were achieved which indicated substantial agreement between model outputs and field results as shown in Table 11.

*MAVIS User's Manual, J.M. Bardis, T.E. Kupfrian, et al., RCA technical report No. CR76-588-008, Burlington, Massachusetts, April 1976.

TABLE 11. MAVIS MODELING PREDICTIONS VERSUS FIELD RESULTS AFTER 12 MONTHS OF TESTING.

	MAVIS PREDICTIONS	FIELD RESULTS
Gain in OR	2.5%	3.4%
Gain in Total MMH/FH	0.967	0.610
Gain in Major Insp MMH/FH	1.078	0.992
Flight Reliability	+0.1%	-0.2%

Comparison of the numbers shown in Table 11 was a strong indicator that MAVIS validation was indeed achieved or achievable. It was then apparent that best use of the third (15 months) validation period could be made if modifications or refinements to the model to improve its validity, accuracy and effectiveness could be made prior to the third validation. These validation runs would then serve as a preliminary test of the modifications originally scheduled for a later date. A comprehensive analysis of the 12-month validation results versus the field results was made and it was decided that adjustments to MAVIS were required in the following areas.

- Use of the term "Availability" rather than "Operational Readiness" since the model counts PMI time as downtime and field OR computations do not.

- Inclusion of a new formula for availability which better accounts for the actual Army field application of manpower during major inspections.

- Addition of model capability to account for less intensive component inspections during PMI's. Originally, it was believed that PMI inspections were the same as PMP inspections on a per component basis.

- Addition of model capability to account for the higher efficiency of phased inspection checklists when compared with PMP lists. Field testing indicated that the average PMP consumes 60 percent more look time than the phased inspection, even though the gross content of the two checklists as field tested were very close to each other at the 100-hour points.

- Modification of the maintenance man-hour computations for daily inspections to account for the fact that a daily inspection is performed immediately after all major inspection points. The original computation assumed that such inspections were not required.

Modifications to the model in the above stated areas were made, and at the conclusion of 15 months of testing, a completely new Master Configuration File was compiled. This file has item-by-item correspondence with the present UH-1H inspection, lubrication, TBO and component retirements and is completely drawn from field data from Project Inspect Phase II with the exceptions of individual component inspection times and abort probabilities. Inspection times for individual components were not a part of the field data. Times utilized in the file are touch times derived from interviews of Fort Campbell personnel and the results of U.S. Navy Time and Motion Studies for UH-1H Aircraft Inspections. Comparatively few aborts occurred during the Fort Campbell test. These aborts are attributed to individual components in the field data. Review of Abort probabilities computed from the field data indicated that, in modes which would cause mission or in-flight aborts computed out to zero abort rates. This is an indication that in this one area the test sample size was too small to provide the desired granularity in data. For this reason component abort rates from the original Project Inspect Phase File, which was drawn from a much larger sample, were used in this final file in all cases except where four or more aborts were attributed to a component per 10,000 flight hours as computed from the field data.

The complete Master Configuration File as utilized in the third set of validation runs is provided in Appendix VII of Reference 1.

VALIDATION REQUIREMENTS AND ACHIEVEMENTS

The basic goals of Project Inspect Phase II are as follows:

- To validate the MAVIS Model capability to produce inspection schedules and checklists which provide increased Operational Readiness at reduced cost without jeopardizing aircraft safety.
- To refine the MAVIS Model to improve its accuracy based upon field experience.

Achievement of the first of these goals was dependent upon three areas. The first was to successfully complete an effective field test program which indicated positive results for the MAVIS generated checklist from Project Inspect Phase I. Second, it was necessary to achieve a test sample size of sufficient magnitude to provide confidence in the field evaluation results. Third, it was important that approximate correspondence exist between field results and MAVIS predictions for the two checklists being compared.

Positive results were achieved in all three areas which contribute to validation. The first requirement, an effective field test, was completed with positive results. At the end of the 15-month test, the test companies achieved increased operational readiness at reduced cost (maintenance man-hours per flight hour) without significant change in flight reliability. Review of the field test results provided in the many tables of the section of this report devoted to Data Reduction and Analysis confirms this statement. In addition, the phased inspection system itself was enthusiastically accepted by the Army personnel who participated in the program. The 15-month test was completed smoothly and methodically without any important problems either with the phased checklist or with aircraft safety.

In the second validation area, the test sample size, statistically calculated during Phase I, indicated that a test sample resulting from 36,000 total flying hours would provide sufficient confidence in the comparative results. A total of 38,342 flying hours was achieved during the test, a figure well in excess of the goal. Further confidence calculations performed at the end of the test confirmed the adequacy of the test sample size.

In the third area, the correspondence between test results and MAVIS predictions, Table 11, and the related discussion presented in the previous paragraphs shows this requirement to have been sufficiently achieved at the end of 12 months of testing.

In summary, it can be stated that the requirements for MAVIS validation were successfully achieved during the test program. The MAVIS Model then, with some refinement to improve its ability to predict the relative merit of competing inspection schemes, can effectively be used in the development of checklists for other aircraft and material.

RESULTS OF FINAL VALIDATION RUNS

As noted in the discussion following Table 11, the final validation runs were made with the MAVIS modified in several areas to improve its validity and accuracy. Furthermore, component data files were compiled with maximum dependence upon the Project Inspect Phase II field data. Validation runs were made for the 25/100 intermediate/periodic and 100/800 phased inspection schemes. The average monthly utilization and average flight duration input to MAVIS were equal to the actual averages over the 15-month test period at Fort Campbell (i.e., 21.3 flight hours per month and 1.3 hours per flight).

Basic field data results to be compared with MAVIS predictions drawn from 15 months of field data are shown in Table 12.

TABLE 12. EVALUATION CRITERIA FIELD RESULTS.

Parameter	Test Group Results	Control Group Results	Delta
Availability	76.9%	74.8*%	2.1%
Major Inspection MMH/FH	1.025	1.937	0.912
Daily Inspection MMH/FH	1.048	0.840	0.208
Total MMH/FH	4.32	4.97	0.65
Mission Reliability	98.4%	98.6%	0.2%

*The availability value for the control group is the field collected OR value modified to consider all PMI times charged as downtime. (Reference should be made to the "May 1975" explanation on page 94.) The availability calculation used is: total group hours in OR Status minus the total group hours expended for PMI's, divided by the total group calendar hours, all multiplied by 100 percent.

The summary results from the two final validation runs are presented in Table 13. Complete copies of the printouts from these runs including all option outputs are presented in Appendices VIII and IX of Reference 1.

TABLE 13. MAVIS MODEL PREDICTIONS FOR VALIDATION.

Parameter	100/800 Phased	25/100 Intermediate/ Periodic	Delta
Availability	96.0%**	93.2%	2.8%
Major Inspection MMH/FH	0.349	0.680	0.331
Daily Inspection MMH/FH	0.886	0.886	0
Total MMH/FH	1.942	2.276	0.334
Mission Reliability	98.1%	98.1%	0

**MAVIS availability projections are greater than typical field values because accounting of NORS times, administrative times, and personnel inefficiency times is not performed. Additionally, the model does not count repair work of one hour or less as operationally ready time as AR95-33 does.

In comparing field results with MAVIS predictions, the differences between model considerations and content of field data in the area of maintenance times must be considered. Field data maintenance man-hour figures contained all time charged by maintenance personnel, including NORS time, administrative time and time required due to personnel inefficiencies. MAVIS operates on the best data available from field collection. Field data includes recorded actuals for repair times by component but provides no breakdown of inspection times by component. Field data (as recorded on the 2407 forms) also does not reconcile directly to OR, NORS or NORM (as recorded on the 1352 forms). MAVIS therefore operates on estimates of per component inspection touch times derived from field interviews and time studies. MAVIS does not consider NORS times, administration time or personnel inefficiency time except where they may be contained within recorded repair times which are used. Consistent one-for-one comparisons can be made between field results for different inspection systems or between MAVIS predictions for these systems. When comparing field results with MAVIS predictions, consideration must be given to these differences in data factors. This is a drawback only in this validation process. When MAVIS is used in the normal evaluation of inspection schemes, it is a direct process since the same Master Configuration File is utilized for all schemes investigated for an aircraft and comparative results are required in selecting the best scheme.

The following are discussions of comparative field results and MAVIS predictions for each of the parameters from Tables 12 and 13.

Availability

The MAVIS Model computations, as noted above, do not consider NORS and do not estimate administrative time or personnel inefficiency. They are therefore higher absolute values than the field results. The predicted and measured Deltas between the inspection schemes are significant. The adjusted MAVIS predicts a 2.8-percent increase in availability, which is close to the 2.1-percent field measured quantity.

Major Inspection MMH/FH

Field results show a saving of 0.912 MMH/FH or 47 percent in major inspection time. MAVIS, utilizing only touch time, predicts a saving of 0.331 MMH/FH or 48.6 percent. MAVIS computations (see Appendices VIII and IX of Reference 1) show total time per 100 flight hours for major inspections to be 69 hours

for the 25/100 scheme and 35 hours for the 100/800 scheme. Table 5 on page 84 of this report shows total field time per 100 flight hours for major inspections to be 193.3 hours for the 25/100 scheme versus 102 hours for the 100/800 scheme. A consistent savings approximating 47 percent exists in all these comparative figures.

Daily Inspection MMH/FH

MAVIS predicts identical times for the two schemes. This should be the case since PMD inspection requirements are the same regardless of inspection scheme and because Army policy dictates the same number of inspections be made over the 100-hour period regardless of inspection scheme. Field data indicates test company PMD's to require 0.208 MMH/FH more than control company PMD's (15 months of cumulative data). It must be noted that in the beginning of the test program PMD recording was highly inconsistent and after three months, test companies PMD times were about 0.790 MMH/FH higher than control company times. After that time, more consistent recording was achieved and the difference converged to the 0.208 value. The data bank is cumulative and therefore contains a permanent skew due to these early recording problems. In this case, it is believed that MAVIS provides the superior comparative result.

Total MMH/FH

Field results show a saving of 0.65 MMH/FH or 13.1 percent in total maintenance man-hours. MAVIS, utilizing touch-time for inspection time and ignoring administrative time and personnel inefficiency predicts a saving of 0.334 MMH/FH or 14.7 percent. The percentage differences are sufficiently close to assure that MAVIS closely tracks actual field manpower expenditures.

Mission Reliability

Field results for mission reliability track closely with MAVIS predictions in absolute value and in the comparative difference between the inspection schemes. MAVIS shows no differences to exist between the schemes while field data indicate a loss of 0.2 percent. These figures are so close that they are reconcilable within the errors that can exist within the round-offs and truncations which are a part of both computer computations.

MAVIS IMPROVEMENTS

During the late stages of Project Inspect Phase II, a number of model improvements and updates were made to the MAVIS Model

calculation program. Most of these improvements were made in preparation for the turnover of the program to the Army, but some were added because they were found to be extremely useful during the validation and checklist update tasks. These improvements are explained as part of the MAVIS User's Manual (Reference 2) but can be enumerated as follows:

- Reorganization of the three MAVIS Programs
- Simplification of the specification of scheme data
- New use of some MCF data fields
- Multiple run and multiple ACF and MCF capability
- 'A' Option Sensitivity Capability

Reorganization of MAVIS Programs

The MAVIS Programs and their subroutines have been organized so their statements are in logical order and they have been liberally supplemented with "comment" statements. This has made the compilation listings far easier to read and obviated the need for detailed flow charts.

A MAVIS run actually consists of three separate programs:

1. Card-to-Disk Program
2. Analysis Program
3. Checklist Program

Figure 29 shows the flow of data and control during a MAVIS run. The Card-to-Disk Program is used to preprocess the Aircraft Configuration File (ACF) and Master Configuration File (MCF) cards for use by the second program. The Card-to-Disk Program also prints the ACF and the MCF disk files. The Analysis Program processes the ACF and MCF disk files created by the first program and generates most of the MAVIS outputs including "Option A", "Option B", and "Option C" outputs as specified by the data cards for each scheme. The third program is used to post-process "Check List" inspection points and intervals generated by the Analysis Program. It prints all components to be checked at each inspection interval by area.

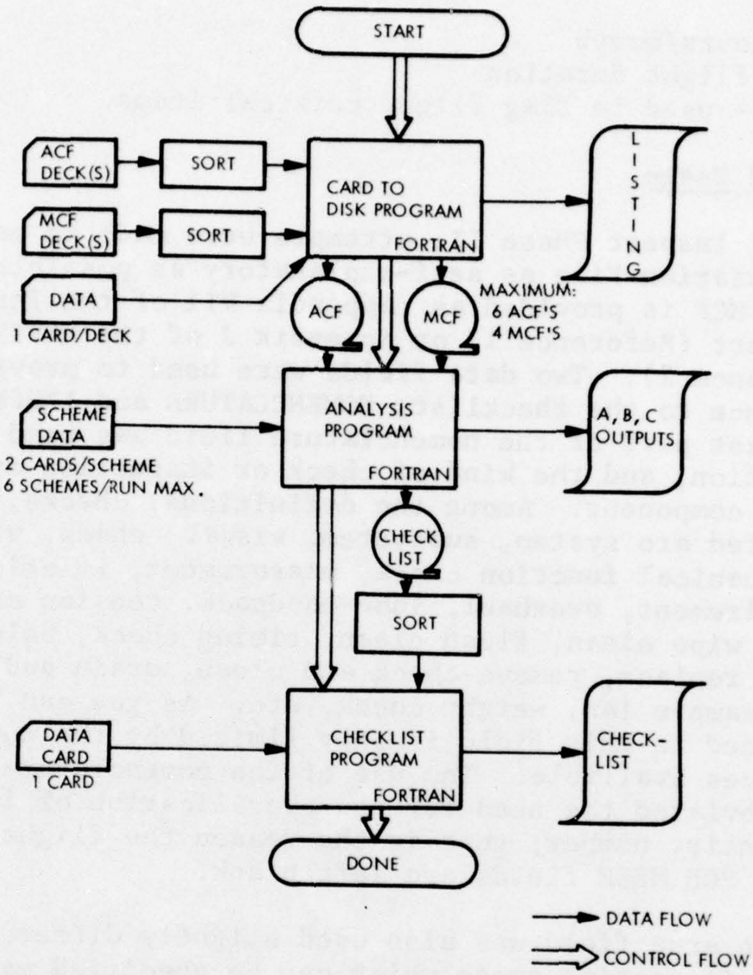


Figure 29. MAVIS Model Programs.

Scheme Data Specification

The inputting of scheme data is now handled by two data cards. The programmer/analyst can now independently specify inspection crew size and repair crew size. Scheme parameters for the Analysis Program include the following:

1. Length of inspection interval } in flight hours or days
2. Length of inspection cycle }
3. Average inspection crew size
4. Average repair crew size
5. Whether preflight, postflight and/or daily (flight readiness) inspections will be allowed

6. Flight hours/month
7. Average flight duration
8. MIN LIM - used to flag flight critical items.

MCF Data Field Usage

During Project Inspect Phase II, attempts were made to make the Master Configuration File as self-explanatory as possible. The final refined MCF is provided as Appendix VII of the Interim Technical Report (Reference 1) or Appendix J of the MAVIS User's Manual (Reference 2). Two data fields were used to provide a direct reference to the checklist, NOMENCLATURE and INSPECTN AREAS. The last part of the nomenclature field was used to indicate definition, and the kind of check or inspection method used for that component. Among the definitions, checks, and functions listed are system, subsystem, visual check, visual function, mechanical function check, measurement, friction check, lube gun, retirement, overhaul, lube-handpack, tension check, remove check, wipe clean, flush clean, timing check, balance track, clean, replace, remove-check and clean, drain and refill, test switch, sample jar, weight check, etc. As you can see, information placed in this field is only limited by the number of character places available. The use of the nomenclature field in this manner obviated the need for the specification of inspection method by identity number; that is the reason the flight readiness (FR) and SCH METH fields are left blank.

The inspection area field was also used slightly differently. The number of inspection areas which can be specified was limited to four to allow listing of both inspection area and checklist step number. Now there is a direct link to the actual written inspection instruction in the checklist.

Multiple Run Capability

As shown on Figure 29, a maximum of six Aircraft Configuration Files and four Master Configuration Files can now be handled by MAVIS. This opens up a number of multiple run possibilities, some of which may be practical. For example, six models of the same aircraft could be run at the same time, four different aircraft can be run at once (all independently analyzed), or six inspection schemes for a given aircraft can be run at the same time.

Sensitivity Analysis Capability

Option 'A' of the MAVIS Model prints out the calculated component data derived from one ACF and one MCF file. Option A basically furnishes data on scheduled and unscheduled inspection and repair maintenance man-hours, abort occurrences, and repair quantities all based on a 10,000 flying-hour simulation for a specified inspection interval. Sensitivity has been added to this option to allow a series of simulations based on the 100-hour, 800-hour cycle inspection scheme. When the sensitivity option is selected, calculations and printouts will be made which provide what happens not only at the specified interval but at 100-, 200-, 400- and 800-hour inspection intervals. Figure 30 illustrates the resulting printout format. Note the first component printed, "Nose Skin/Structure", had 100 hours as the input specified interval while the second component, "Roof Windows", had 400 hours specified.

CHECKLIST UPDATE

One of the last major tasks of Project Inspect Phase II was to update and in some areas rewrite the phased inspection checklist tested at Fort Campbell. This effort could not be started until the data bank was complete, and the MAVIS Model refined and validated. Data gathered from the test was sufficiently accurate and far superior to the original design data used in Phase I. Therefore, an almost complete redesign of the schedule and checklist was performed. Component intervals and the inspection mix were adjusted in accordance with the final refined MAVIS run results (refer to Appendix K of Reference 2). Checklist statements were rewritten to incorporate inspection techniques used and to ensure inspection for the high failure causes of all components as denoted by the Fort Campbell data bank. Finally, the checklist steps were typed on a new format derived from RCA-AVSCOM discussions.

MAVIS Modeling Influence On Checklist

The MAVIS Modeling work heavily influenced three changes to the checklist:

- Inspection Step Technique Additions
- Inspection Area Adjustment
- Inspection Interval Adjustment

The MAVIS User's Manual (Reference 2) explains in detail the work involved in making these adjustments and additions. The

INSP SCHEME - 100/800		INSPECTION SCHEME COMPONENT SUMMARY	PAGE 2
HELO MODEL - UH-1		RATES PER 10,000 FLIGHT-HOURS	11MAR76

WUC	NOMENCLATURE	QTY/ AREA	PREV RE- PAIR	UNSCH RE- PAIR	F.R. INSP M/H	SCHD INSP M/H	PREV REPR M/H	UNSCH REPR M/H	TOTAL M/H	PREV REPR EMT	UNSCH REPR EMT	MIS- SION ABORT	IN- FLT ABORT	INTVL BETW INSP
1111050	NOSE SKIN/STRUCTURE-VISUAL CHK.	8/ 2	1	0	118	16	5	2	141	18	2	0.01	0.01	100.0
			1	0	118	16	5	2	141	18	2	0.01	0.01	100.0
			1	1	118	8	2	4	133	12	4	0.02	0.01	200.0
			0	1	118	4	1	5	129	9	5	0.03	0.02	400.0
			0	2	118	2	1	6	127	8	6	0.04	0.02	800.0
	SUBSYSTEM TOTAL		14	14	237	37	70	80	425	44	46	1	0	
1112000	CENTER FUSELAGE -SUBSYSTEM													
1112010	ROOF WINDOWS -VISUAL CHK	2/10	1	6	26	1	4	31	62	17	16	0.23	0.23	400.0
			3	3	26	3	18	18	65	13	9	0.13	0.13	100.0
			2	5	26	2	9	27	63	16	14	0.20	0.19	200.0
			1	6	26	1	4	31	62	17	16	0.23	0.23	400.0
			0	6	26	0	2	34	62	18	17	0.25	0.24	800.0
1112020	XMSN COWLING -VISUAL CHK	1/10	0	2	19	11	0	3	33	13	3	0.03	0.0	100.0
			0	2	19	11	0	3	33	13	3	0.03	0.0	100.0
			0	2	19	5	0	3	28	8	3	0.03	0.0	200.0
			0	2	19	3	0	3	25	6	3	0.03	0.0	400.0
			0	2	19	1	0	3	24	4	3	0.03	0.0	800.0
1112030	ENGINE COWLING -VIS FUNCTN	2/16	3	6	38	33	6	14	92	48	14	0.0	0.0	100.0
			3	6	38	33	6	14	92	48	14	0.0	0.0	100.0
			1	8	38	17	3	17	75	34	17	0.0	0.0	200.0
			1	8	38	8	1	19	67	27	19	0.0	0.0	400.0
			0	9	38	4	1	19	63	23	19	0.0	0.0	800.0
1112060	FIREWALLS -VISUAL CHK	4/17	1	0	26	5	1	0	32	5	0	0.0	0.0	100.0
			1	0	26	5	1	0	32	5	0	0.0	0.0	100.0
			0	0	26	3	1	1	30	3	1	0.0	0.0	200.0
			0	1	26	1	0	1	28	2	1	0.0	0.0	400.0
			0	1	26	1	0	1	28	2	1	0.0	0.0	800.0

Figure 30. Inspection Scheme Component Summary Sensitivity Printout.

inspection interval adjustments were made using the MAVIS Option 'A' output. Option 'A' provides component data rates per 10,000 flight hours and is a close link to the inspection steps themselves. The sensitivity feature illustrated in Figure 30 was used to simplify this selection process. Three component rates were used to select the optimum interval: total MMH, mission aborts, and the component contribution to downtime. The first two items are a part of the normal 'A' Option printout, but the last item was specially programmed for the UH-1H checklist update. Space on the 'A' Option printout has been fully assigned; this precluded the latter items addition to the delivered MAVIS Model. The sensitivity feature was very helpful in shortening a normally iterative computer run process. This allowed the analyst to select the optimum interval with a minimum of study.

Checklist Format

The checklist format used for the field test (Figure 31) was selected for its compatibility with the current intermediate-periodic checklists to assure a fair comparative field test. As such, it had a number of weaknesses which were known before the test and emphasized by the test. Foremost among the current checklist documentation inefficiencies is the fact that they are not working documents. Users in the field must copy portions of the checklists from plastic cards onto the DA Form 2404 in order to record status, deficiences and corrections. This is a step that can be eliminated by providing a "work oriented" checklist.

Such a checklist has been designed by RCA/AVSCOM personnel and is illustrated in Figure 32. Study of the format also resulted in a number of content-related recommendations. These stated that the checklist should include:

- Single-side printing at appropriate inspection package and system break points
- Contents
  - Area and access cover lists with drawings
  - Preparatory instructions for inspection
  - Area organized inspection steps
  - Power-on checks
  - Reference to Avionics and Armament inspections.

Final UH-1H Checklist

The final UH-1H Phased Inspection Checklist is presented in Appendix A. The magnitude of work involved in refining it can be

PUBLICATION NO.	Unassigned	AREA NO. 12
PUBLICATION DATE:	1 June 73	Main Rotor and Mast Area
CHANGE NO.	None	ELECTRIC POWER ☐ ON ☒ OFF

PHASE NO.								INSPECTION REQUIREMENT	MECH.
1	2	3	4	5	6	7	8	1. Main rotor blades for scratches, nicks, dents, erosion of leading edge, and evidence of bond failures. Para. 8-4.	
1	2	3	4	5	6	7	8	2. Main rotor hub, blade grips, pitch horns, and drag braces for visible damage and security. Para. 8-5.	
1	2	3	4	5	6	7	8	3. Main rotor pillow block and grip reservoirs for oil level, leakage, and contamination. Para. 8-5.	
1	2	3	4	5	6	7	8	4. Main rotor pillow block reservoir sight glasses cleaned (interior surface) and reservoir flushed.	
	2		4		6		8	5. Main rotor grip reservoir sight glasses cleaned (interior surface) and reservoir flushed.	
1	2	3	4	5	6	7	8	6. Main rotor pitch links for excessive radial or axial play in bearings. Para. 8-3.	
1	2	3	4	5	6	7	8	7. Stabilizer bar and connecting linkage for nicks, scratches, dents, and worn bearings. Para. 8-6.	
1	2	3	4	5	6	7	8	8. Stabilizer bar tube assembly for cracks. Pay particular attention to inboard 5 inches where tube assembly attaches to stabilizer bar centerframe. Para. 8-6.	
1	2	3	4	5	6	7	8	9. Stabilizer dampers for full fluid level and proper timing.	
1	2	3	4	5	6	7	8	10. Main rotor mast for distortion, cracks and dents. Para. 8-2.	
	2		4		6		8	11. Main rotor mast dust boot for deterioration and security.	
	2		4		6		8	12. Collective sleeve drive plate for excessive play where engaged with main rotor mast splines.	

Figure 31. Checklist Format Used During Field Evaluation.

PHASE NO.________

TM 55-1520-210-PI
PHASE INSPECTION CHECKLIST

Area Name and No.	Aircraft Serial No.	Date	Total Hrs. This Area

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial

Figure 32. Project Inspect Phase II Developed Checklist Format.

simply stated by comparing the number of inspection steps and inspection intervals with the checklist tested at Fort Campbell. Excluding Power On checks, the new checklist contains 293 steps, while the old one contained 239 steps. Table 14 lists the interval percentages for each checklist. Those components affected by the 100-hour interval have been drastically reduced, while a corresponding increase in 200, 400, and 800 hour intervals has occurred. The new inspection steps have also been made more specific as to the inspection method and the component involved.

TABLE 14. INTERVAL CHANGES - UH-1H PHASED CHECKLIST.

INTERVAL (HRS)	OLD CHECK-LIST (%)	NEW CHECK-LIST (%)	INCREASE (%)
100	71.3	38.1	(33.2)
200	19.8	20.4	0.6
400	5.9	31.6	25.7
800	3.0	9.9	6.9

In addition, a human factors approach was used that reduced "up-down" motion and promoted a "walk-around" philosophy where applicable. The inspection areas and inspection steps within an area have also been ordered using human factors considerations. The magnitude of the changes are sufficient to warrant a new validation effort by experienced technical inspectors. The validation process should determine the minimum list of access panels by phase and add this list to the checklist. This will reduce inspection time by eliminating unnecessary inspections (mechanics and TI's have a tendency to inspect an area if it is exposed). It is also recommended that the validation team determine optimum "split" points so a three-man inspection team can be utilized effectively. The checklist is currently ordered optimumly for one man to carry out the complete inspection. The determination of "split" points will allow a team to remove a part of the checklist and to parcel out the inspection responsibilities.

PHASED INSPECTION SYSTEM TEST RESULTS

Many of the test results have been presented in the sections entitled Data Reduction and Analysis and MAVIS Model Refinement and Validation. Disregarding possible data biases previously discussed, cumulative data produced by the DMS system indicates the following test group advantages that occurred under Fort Campbell operational conditions:

- 1.1 Percent Increased OR (1352 Data)
- 0.70 MMH/FH Savings in Inspection Labor
- 0.65 MMH/FH Total Labor Savings
- Lower Spares Usage and Costs ($942,898)

This section presents refined MAVIS results and confidence calculation results, and discusses the phased systems apparent effect on support costs and labor distribution.

MAVIS SUMMARY RESULTS

MAVIS results have been given and discussed previously in relation to the validation and model refining work. However, after the validation was accomplished and the model completely refined and updated, a final MAVIS run was made to indicate the improvement offered by the new checklist over the old checklist. Figure 33 presents those results in inspection scheme summary matrix form.

	25/100 UH-1H	VALIDATED UH-1H	REFINED (NEW CHECKLIST)
FLIGHT RELIABILITY	0.992	0.992	0.993
MISSION RELIABILITY	0.981	0.981	0.981
AVAILABILITY	0.932	0.960	0.964
NORM - SCHEDULED	0.060	0.031	0.027
NORM - UNSCHEDULED	0.008	0.009	0.009
MH/FH - FLT-READINESS INSP	0.886	0.886	0.886
MH/FH - SCHEDULED - LOOK	0.680	0.349	0.291
MH/FH - SCHEDULED - FIX	0.355	0.299	0.287
MH/FH - UNSCHEDULED MAINTENANCE	0.355	0.408	0.420
MH/FH - TOTAL	2.276	1.942	1.883
UNSCHEDULED MTBM	8.3	7.3	7.1

Figure 33. Combined Final MAVIS Results.

Listed are the summary results for the intermediate/periodic inspection scheme (25/100), the phased inspection system tested at Fort Campbell (Validated), and the new inspection schedule provided in Appendix A of this report (Refined). The latter inspection scheme results show the improvements predicted by the model for the final checklist update effort. This includes both inspection interval and inspection mix changes. Note that mission reliability, NORM and flight reliability stay about the same but that availability increases slightly. In turn, the unscheduled mean-time-between-maintenance actions (MTBM) improves by 0.2 of an hour. By far the greatest effect is in the labor area. Both scheduled inspect and repair time have improved, resulting in a saving of 3 percent. This saving is on top of the 14.7 percent saving achieved by the validated checklist over the 25/100 checklist. The 25/100 column is provided to furnish MAVIS comparison data for the intermediate/periodic inspection system.

Comparison With Early MAVIS Work

Phase I of Project Inspect developed the first version of the 100/800 phased inspection system for the UH-1H aircraft. That development effort was based on a UH-1 MAVIS data bank drawn from combined 3-M (Navy, Marines) and Army sources. Phase I developed the checklist tested by Phase II. The inspection intervals in that checklist were conservatively selected via liberal use of engineering judgement because of a "lack of faith" in the combined data bank. It is of note that many of the conservative judgements made during Phase I did not need to be made during Phase II. The Phase II sample data collection produced data of high accuracy, enabling removal of overly conservative influences on the new checklist.

Figure 34 illustrates the high improvement Phase II achieved over Phase I in terms of the MAVIS modeling projections. The Phase I modeling work was performed and presented in April 1973 and does not include the validation model improvements noted in the previous section. However, the improvement is of a magnitude (with the exception of availability) to prove the importance of sample data collection and the importance of refining a checklist after it has been used for a period of time.

	PHASE I MODELING	PHASE II MODELING (NEW CHECKLIST)
FLIGHT RELIABILITY	0.979	0.993
MISSION RELIABILITY	0.927	0.981
AVAILABILITY	0.967	0.964
NORM - SCHEDULED	0.018	0.027
NORM - UNSCHEDULED	0.015	0.009
MH/FH - FLT-READINESS INSP	1.653	0.886
MH/FH - SCHEDULED - LOOK	0.589	0.291
MH/FH - SCHEDULED - FIX	0.427	0.287
MH/FH - UNSCHEDULED MAINTENANCE	0.776	0.420
MH/FH - TOTAL	3.446	1.883
UNSCHEDULED MTBM	3.5	7.1
AVERAGE UTILIZATION (FH/MO.)	25	21.3
AVERAGE FLIGHT DURATION (HRS.)	2.9	1.3

Figure 34. MAVIS Summary Results, Project Inspect, Phase I and II.

CONFIDENCE RESULTS

In the Project Inspect Phase II proposal, a field test consisting of sample data gathering for a period of 12 months (36,000 flying hours) was recommended. A statistical analysis was performed at that time to estimate the length of time required and to project the confidence in evaluation results obtainable (to provide a determinant comparison between the two inspection systems). A confidence level of 80 percent was projected for 36,000 flying hours.

At the end of the formal field evaluation, confidence calculations were performed to determine the statistical confidence in the DMS results, indicating that the phased inspection schedule was indeed superior to the intermediate/periodic schedule. Confidence calculations were performed while testing the variables OR and MMH/FH to determine if the field test was statistically successful. The statistical method used (refer to Appendix B) has the following statement (Case 2, Paragraph 3-3, AMCP 706-110): The variability in performance of each A (Test Group) and B (Control Group) is unknown, and it is not reasonable to assume that they both have the same variability. The result of the Test versus Control comparison for MMH/FH showed an overwhelming confidence in the improved result achieved by the Test Group. However, it was noted that company selection to each group was extremely important to the

outcome. This triggered further calculations comparing the test companies of one BN with the test companies of the other BN. Similarly, the control companies of one BN were compared with the control company of the other BN. An interesting and perhaps unexpected result occurred. These comparisons indicated a very high confidence that the two Battalions were from completely different populations. (Refer to Appendix B.) In other words, for statistical evaluation purposes, the two battalions were found to perform and report so differently that they should not be lumped together in terms of Project Inspect's Test and Control Groups. Therefore, to compare test versus control results, calculations had to be performed within the same battalion. This had the effect of cutting the sample size drastically but it produced two test versus control sample comparisons, one for each battalion. (Refer to Appendix C for OR and MMH/FH data on these two samples.) The results of the calculations are provided in Table 15.

TABLE 15. CONFIDENCE ESTIMATE FOR FIELD RESULTS.

Test Companies	Control Companies	Tested Variable	Confidence Level
B, D-101st BN	C-101st BN	OR	94.2%
B, D-101st BN	C-101st BN	MMH/FH	98.1%
D-158th BN	B, C-158th BN	OR	83.4%
D-158th BN	B, C-158th BN	MMH/FH	88.4%

Note that in both battalions, a higher confidence level was achieved for the variable MMH/FH. This indicates that there is higher confidence in the interval estimate of the true difference of MMH/FH between the test and control companies. In all calculations, the confidence level exceeded the original projection. These results clearly indicate that a determinant comparison between the two inspection systems has been achieved. Furthermore, the superior results accomplished by the test companies should be looked at with high confidence.

SUPPORT COST EFFECT

The test implementation of the phased inspection schedule resulted in a savings due primarily to a reduction in inspection workload. This reduced labor costs (MMH/FH) from 4.974 for the control group to 4.322 for the test group. The inspection portion of the workload can be considered to consist of the following inspection types: PMD, PMI, Special, Phased and PMP. In the case of the test group, the inspection portion of the total workload was 58.8 percent while in the control group it was 62.9 percent. Figure 35

illustrates the overall maintenance man-hour distribution in pie chart form.

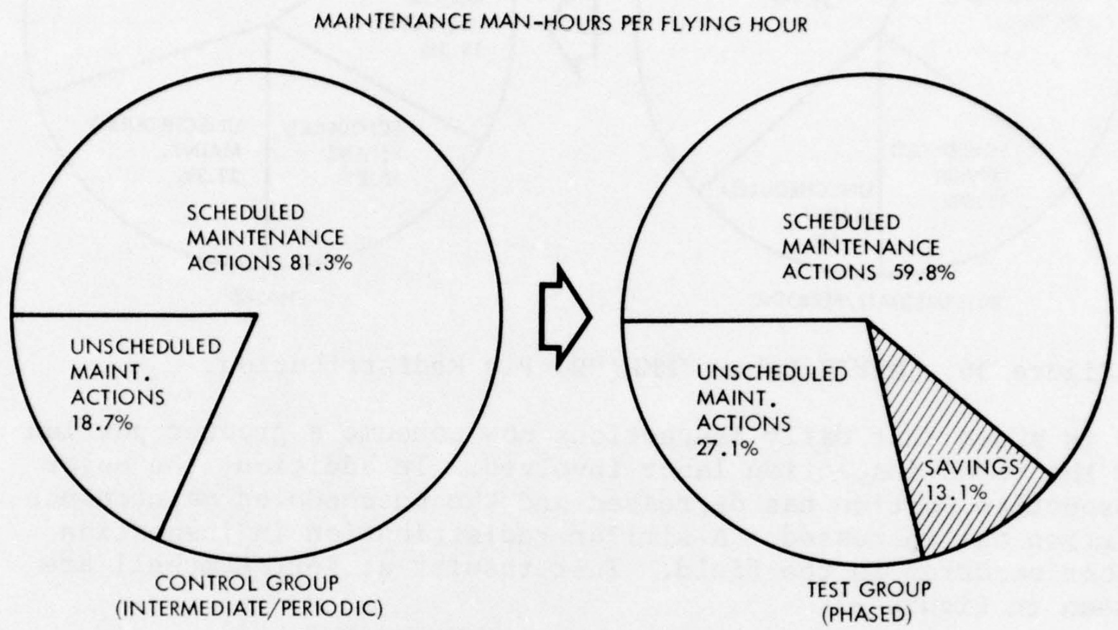


Figure 35. Project Inspect UH-1H Support Cost Changes.

The test group breakdown has been computed from the same base as the control group (4.974 MMH/FH). The change shown indicates a small increase in unscheduled maintenance actions, a large decrease in scheduled maintenance actions and savings of 13.1 percent.

LABOR REDISTRIBUTION

From early MAVIS Modeling work it was evident that labor (MMH/FH) spent for the different inspection types would change or be redistributed with the implementation of the phased inspection schedule. This can be shown by looking at the modeling results provided in Figure 33. The "Refined" and "25/100" data columns of Figure 33 have been drawn in pie chart form to illustrate this point. Figure 36 shows the results.

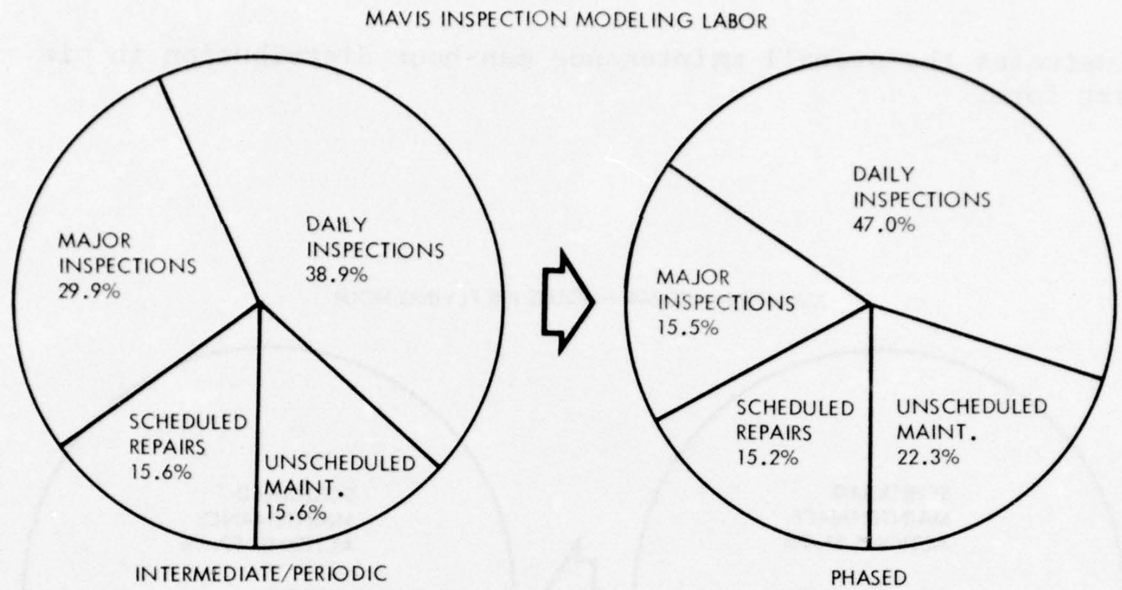


Figure 36. MAVIS Labor (MMH/FH) Pie Redistribution.

It is shown that daily inspections now consume a greater portion of the total inspection labor involved. In addition, the major inspection portion has decreased and the unscheduled maintenance portion has increased. A similar redistribution in inspection labor occurred in the field. Test results at Fort Campbell are shown in Figure 37.

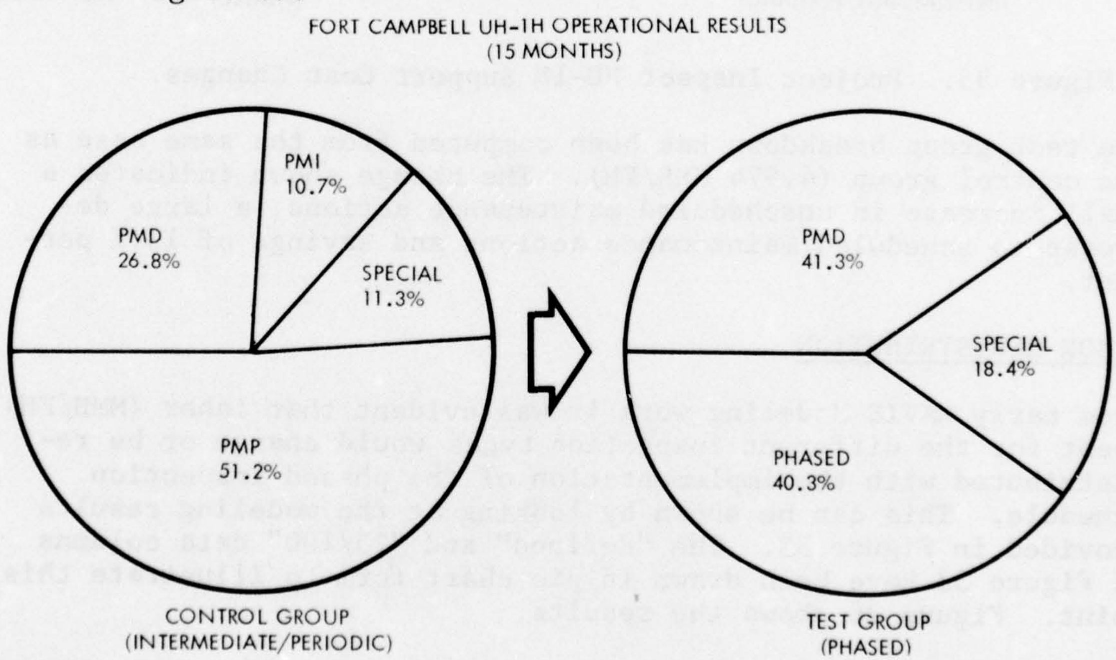


Figure 37. Inspection Labor (MMH/FH) Pie Redistribution.

The redistribution of daily inspection (PMD) labor is clearly shown as an increase. *The major inspections* of the control group (PMP and PMI) decrease to form the "Phased" portion of the pie in the test group. Also resulting, is a small increase in the special inspection category. This is caused primarily by the fact that a smaller total labor base was used to compute the test group percentage figures. (The test group's total for inspection labor is lower than the control group's.) It can be concluded that phased inspection system implementation has provided an overall labor saving (Figure 35), a reduction in inspection related labor, and a redistribution of effort spent performing the various inspections. Further efficiency improvements are possible, and it would be logical to reduce the greatest consumer of inspection labor, the daily inspection.

CONCLUSIONS

1. Project Inspect, Phase II, has successfully proved that the MAVIS Model can produce inspection schedules and checklists that provide increased inspection efficiency at reduced cost without jeopardizing aircraft safety. In addition, the integration of the MAVIS-designed phased inspection checklist into Army operational activity was accomplished with ease and was well received by Fort Campbell user personnel.

2. Statistical calculations also showed that the field evaluation was successful. Confidence levels for availability and maintenance man-hours per flight hour were computed for each battalion used in the test. The calculations indicated an 83 to 98 percent confidence that the test companies produced better availability and fewer MMH/FH than the control companies.

3. The largest problem faced by the field evaluation was accurate data recording. Line-by-line review, correction, and transcription was utilized to improve the process. It can be concluded that data collection within the Army must be controlled for it to be useful in maintenance planning.

4. Aviation unit personnel are subject to too much paperwork, particularly that which is imposed by TAMMS. The net effect is less time spent on active operational duties and perhaps lower morale in some instances.

5. Data recording and data collection training within the Army is inadequate. Few new men knew how to adequately complete a 2407 TAMMS form.

6. Project Inspect, Phase II, field activity resulted in a semicontrolled data collection program rather than a controlled field evaluation. (Semicontrolled data collection is where the trooper fills out the form and a technical assistance representative of the commodity command reviews, edits, collects, and forwards it to the national level. Controlled data collection utilizes commodity command personnel to record and collect the data with no requirements placed on field personnel.)

7. Initial implementation of the Phased Inspection System throughout Army Aviation will produce savings and redistribute inspection labor to a point where as much time is spent performing daily inspections as there is in performing major inspections. (Refer to Figure 37.)

8. The new Phased Inspection Checklist Format developed during the program is expected to improve the quality of component status, deficiencies found, and repair action recording. Furthermore, a thorough local aircraft record will be available for new company maintenance personnel to research past aircraft maintenance problems.

RECOMMENDATIONS

1. MAVIS designed Phased Inspection Schedules should be implemented for other aircraft in the Army inventory and for new aircraft that are scheduled to become a part of the inventory.

2. Once an inspection schedule becomes operational, it should be periodically reexamined and updated using the same design technique that it was implemented by (MAVIS Analysis).

3. Army aviation should follow the lead of other commodity commands and simplify current TAMMS data recording requirements. For example, many of the forms required today furnish duplicate information. Some of these can be eliminated or combined, resulting in more efficient data collection.

4. Sample Data Collection (SDC) should be widely used to provide needed maintenance planning data. It is recommended that the semicontrolled method of SDC be employed. One AVSCOM or contractor field representative should be resident with each Aviation Company where SDC is used.

5. The inefficiencies and inaccuracies of TAMMS data recording and collection can be largely overcome with field-implemented hardware computer processing aids. Therefore, it is recommended that SDC aviation implementation employ simple, low-cost field processing systems with data correcting (interactive) hand-held or fixed data entry terminals. The same system should be programmed to provide needed operational data for company, battalion and group AMOs and COs. The SDC hardware should be compatible with ATSS, the avionic test system to be implemented.

6. Improved MOS training in TAMMS data collection principles and data recording practices should be undertaken. Practical data-recording classroom exercises are recommended for inclusion in the instructional curriculum. Added SDC topics should also be covered. On-post on-the-job training (OJT) programs and lectures are also recommended.

7. Under the phased inspection schedule, field results have shown that the daily inspection assumes a greater proportion of total inspection labor requirements (over 40 percent). It is believed that this requirement can be reduced via a systems engineering analysis and the reorganization/rewriting of the PMD checklist. It is recommended that such an analysis be performed and the resulting PMD checklist field tested.

8. Further development of the MAVIS Model is advised. For a given set of conditions, the model can be programmed to select an "optimum" inspection interval or provide a "figure of merit" for inspection intervals in a sensitivity run. Additionally, TOS sensitivity data outputs can be incorporated to determine component candidates for the application of new inspection methods or tools. Cost analyses could then determine where such application would be most beneficial and lead to research efforts in these areas. Finally, the model could be modified to provide inspection schedule data suited to a wartime scenario. Penalties can be assessed for unscheduled repairs and similar activity. One or more of the above research and development efforts are recommended.

REFERENCES

1. Interim Technical Report, Tasks I-V, Project Inspect Phase II, Fred W. Hohn, Bruce B. Wierenga, et al., RCA Technical Report CR76-588-007, Burlington, Mass., Prepared for Eustis Directorate, U.S. Army Air Mobility Research and Development Laboratory, Fort Eustis, Va. 23604, March 1976.

2. MAVIS User's Manual, James M. Bardis, Ted E. Kupfrian, et al., RCA Technical Report CR76-588-008, Burlington, Mass., Prepared for Eustis Directorate, U.S. Army Air Mobility Research and Development Laboratory, Fort Eustis, Va. 23604, April 1976.

APPENDIX A

PHASED INSPECTION CHECKLIST, UH-1H HELICOPTER

PHASED

INSPECTION CHECKLIST

UH-1 HELICOPTER

Prepared Under

Contract No. DAAJ02-74-C-0044

1 April 1976

GENERAL INFORMATION

1. Inspection Requirements. This checklist contains minimum requirements for inspection of the UH-1H helicopter on a phased schedule having an 800 hour (flight hours) cycle with 100 hour phases. Each requirement included herein is designated for accomplishment at least once, but not more than eight times during the 800 hour cycle. Applicable phase numbers are listed beside each inspection requirement. After completion of each 800 hour cycle (Phases 1 through 8), another cycle begins with Phase 1 requirements.

   The checklist does not contain instructions for repair, adjustment, or other means of rectifying conditions, nor does it contain instructions for troubleshooting to find causes for malfunctioning. Special tolerances, limits, etc., can be found in the applicable maintenance manuals. Use of the alphabetical index in the applicable manuals will facilitate locating the required information.

2. Scope. The inspections prescribed by this checklist will be accomplished at specified phases by organizational maintenance activities with assistance of direct and general support activities when required. Space is provided for inspecting personnel to record discovered faults and corrective actions taken.

3. General Information.

   a. The inspection requirements contained herein are stated in such a manner as to establish when certain equipment is to be inspected and what conditions are desired. Compliance with the provisions outlined herein is required in order to assure that latent defects are discovered and corrected before malfunctioning or serious trouble results. In order to arrange inspection requirements as nearly as possible according to the manner in which work will be accomplished, the requirements in each area are divided into groups under Area headings (see Figures 1 and 2). An Area title indicates a specific aircraft location which may be comprised of several systems or groups of related components within this given area.

   b. The inspection intervals designated herein are the maximum and should not be exceeded. When unusual local conditions (utilization, type of mission, experience of flight and maintenance personnel, periods of inactivity, environmental conditions, etc.,) dictate, it is the prerogative and responsibility of the Maintenance Officer to increase the scope of frequency of maintenance or inspections as necessary to insure safe operation (TM 55-1500-328-25).

3. <u>General Information</u> (Continued)

c. This checklist pertains to all UH-1H helicopters and may therefore contain inspection requirements applicable to specific equipment not installed on individual helicopters. When this situation is encountered, those requirements that are not applicable should be disregarded.

d. Upon completion of the inspection, all uncorrected deficiencies or shortcomings listed on the checklist will be entered on DA Form 2408-13 (Aircraft Inspection and Maintenance Record) prepared for that date.

e. <u>Test Flights</u>. A general test flight is mandatory after each phase inspection (TM 55-1500-328-25).

f. <u>Inspection Areas</u>. Inspection areas are listed below, and shown in Figures 1 and 2.

Area No.	Area Title
1	Nose Area Exterior
2	Fwd Radio/Battery Compartment
3	Cockpit Interior
4	Cabin Interior
5	Under-Floor of Cockpit/Cabin
6	Lower Pylon Area (Via Cabin Interior)
7	Upper Pylon Area (Via Cabin Roof)
8	Engine Air Induction Area
9	Main Rotor and Mast Area

3. General Information (Continued)

f. Inspection Areas (Continued)

Area No.	Area Title
10	Cabin Roof Exterior
11	Cabin Exterior Sides, Bottom and Landing Gear
12	Under Cabin Pylon Area (Hell Hole)
13	Mid Fuselage Under Engine Deck
14	Center Fuselage Exterior
15	Electronic/Comm. Compartments
16	Engine Area Exterior
17	Engine Compartment
18	Tailboom Exterior
19	Tailboom Interior
20	T.R. Drive Train Area
21	Tail Rotor and Gearbox Area
22	Oil Cooler/Aft Batt. Compartment
23	Heater Compartment

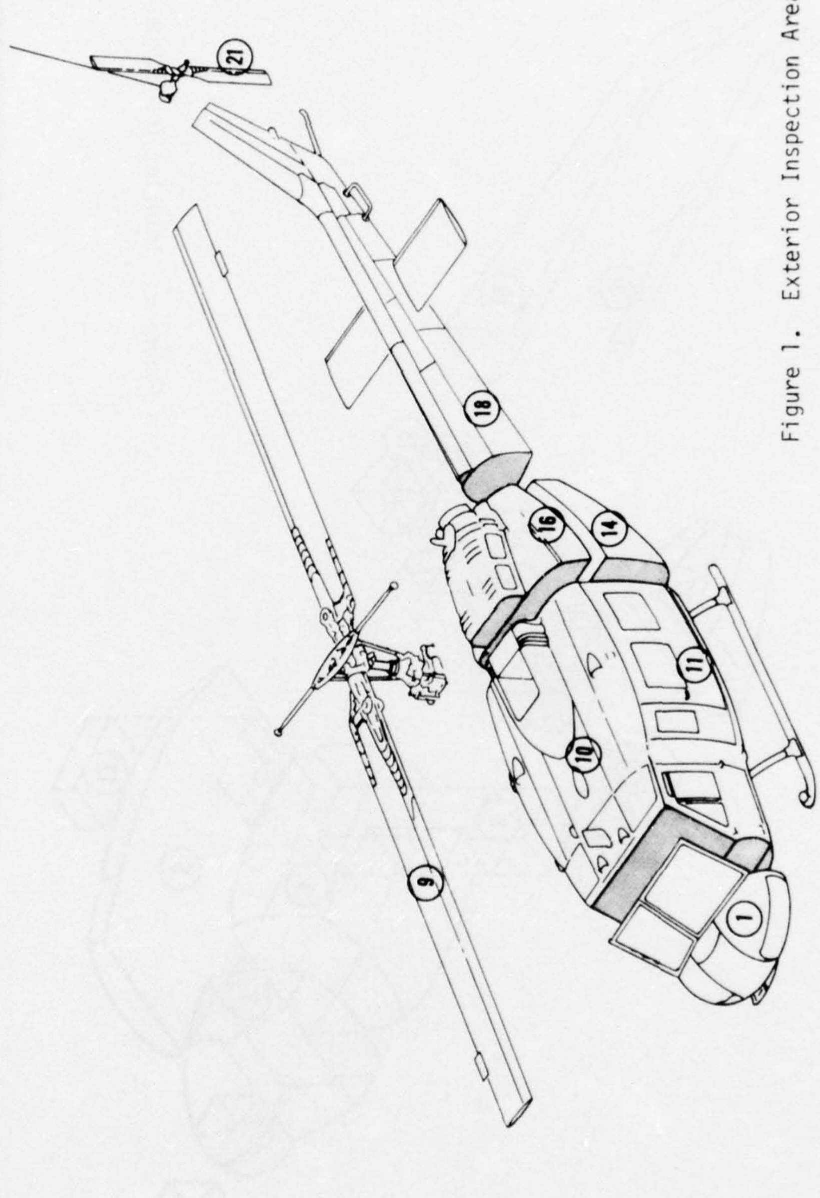


Figure 1. Exterior Inspection Areas

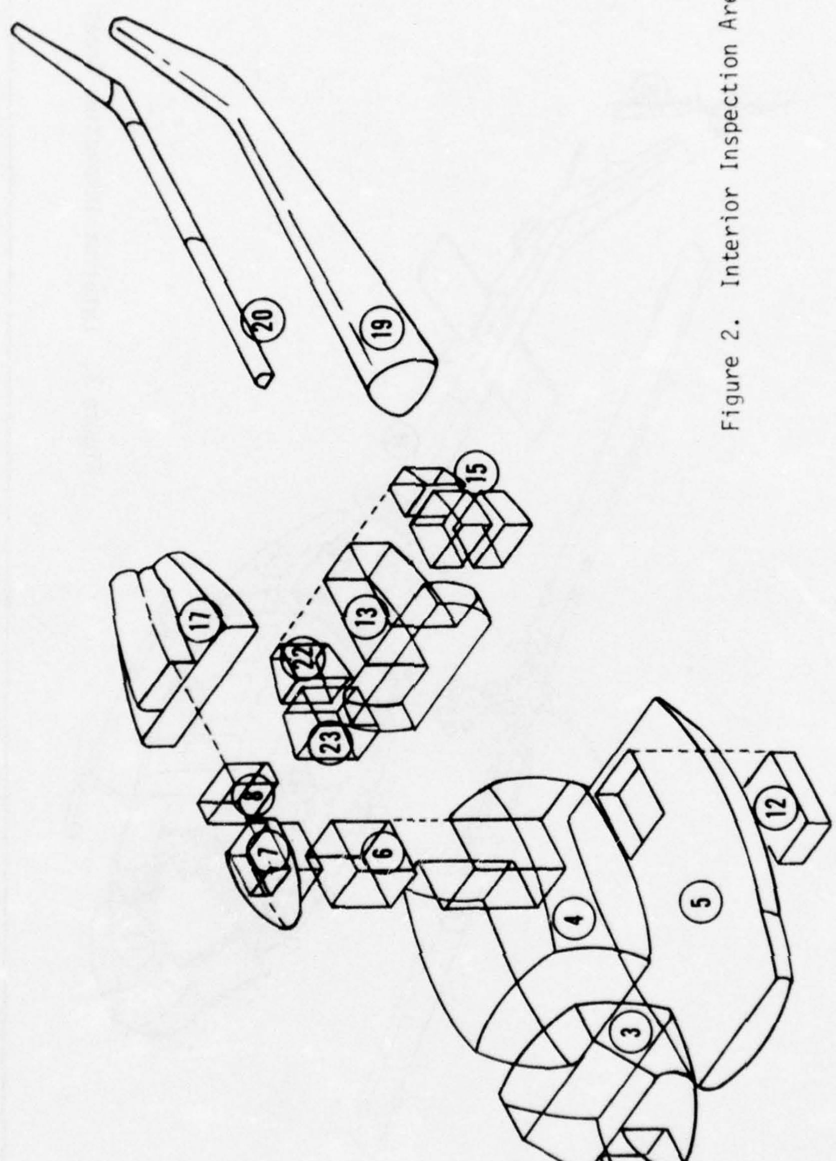


Figure 2. Interior Inspection Areas

1. NOMENCLATURE	2. MODEL	3. SERIAL NUMBER	4. PAGE NO. / NO. OF PAGES
HELICOPTER, UTILITY TACTICAL TRANSPORT	UH-1H		1 / 1

5. ITEM TO BE INSPECTED	6. REFERENCE	7. FREQUENCY	8. NEXT DUE
T/R Lube Due	TM55-1520-210-20	25 Hours	
(7) T/R P/C Links Disconnected	TM55-1520-210-20	25 Hours	
Engine Oil Sample Due	TM55-1520-210-20	12½ and 25 Hours	
Transmission Oil Sample Due	TM55-1520-210-20	25 Hours	
42° G/B Oil Sample Due	TM55-1520-210-20	25 Hours	
90° G/B Oil Sample Due	TM55-1520-210-20	25 Hours	
Hydraulic Oil Sample Due	TM55-1520-210-20	25 Hours	
(7) 90° G/B Mag Plug Removed	TM55-1520-210-20	25 Hours	
(7) 42° G/B Mag Plug Removed	TM55-1520-210-20	25 Hours	
(7) Xmsn Mag Plug Removed	TM55-1520-210-20	25 Hours	
(7) Engine Servo Filter Removed	TM55-1520-210-20	50 Hours	
Clean and Inspect M/R Blades	TM55-1520-210-20	25 Hours	
First Aid Kit PM Check	TM55-1520-210-20	25 Hours	
Fire Extinguisher PM Check	TM55-1520-210-20	25 Hours	
Nic CAD Battery PM Check	TM55-1520-210-20	25 Hours or 7 days	
Outer Control Plate Trunions Lube	TM55-1520-210-20	50 Hours	
Collective Lever Trunion Lube	TM55-1520-210-20	50 Hours	
Control Plate Trunion Lube	TM55-1520-210-20	25 Hours	

DA FORM 2408-18, 1 JAN 64

EQUIPMENT INSPECTION LIST
(TM 38-750)

1. LIST OF ACCESS AND INSPECTION DOORS, PANELS AND COVERS BY PHASE NUMBER TO BE ADDED.

2. FIGURE OF UH-1H HELICOPTER ACCESS AND INSPECTION PROVISIONS TO BE ADDED (REFERENCE: TM55-1520-210-20, FIGURE 4-2.)

PHASE NO.______

TM 55-1520-210-PI
PHASE INSPECTION CHECKLIST

Area Name and No.		Aircraft Serial No.		Date	Total Hrs. This Area
General					

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	1. Prior to inspection, check aircraft forms and records for recorded deficiencies (TM 38-750).				
EACH 50 HRS	2. Lubricate in accordance with lubrication chart contained in Chapter 2, Section II of TM 55-1520-210-20.				
ALL	3. Fuel tanks shall be fully serviced prior to start of phased inspection.				
ALL	4. Perform Avionics inspections. Check and test electronic equipment as required in TM 11-1520-210-20 and 20-1.				
ALL	5. Perform armament system inspections, checks and tests as required in applicable armament publications.				
ALL	6. After inspection ascertain that all entries on forms, records, and worksheets have been completed or updated and new forms initiated as required (TM 38-750).				

PHASE NO.________

TM 55-1520-210-PI

PHASE INSPECTION CHECKLIST

Area Name and No.: Nose Area Exterior 1

Aircraft Serial No.: | Date: | Total Hrs. This Area:

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	1. Windshields for distortion, cracks, scratches, discoloration and cleanliness.				
1357	2. Windshield wiper blades for wear and deterioration. Wiper blade arms for condition, security and proper adjustment.				
1	3. Nose section exterior for damage, skin cracks, and loose or missing rivets. Paint for chipped or peeling condition.				
ALL	4. Nose compartment door for cracks, dents and damage. Door latches for damage and proper operation. Door hinges for cracks and damage.				
ALL	5. Lower nose windows for cracks, crazing and cleanliness.				
1	6. Aircraft air temperature (OAT) gauge removed, tested and re-installed (TM 55-1520-210-20).				

2

PHASE NO._______

TM 55-1520-210-PI
PHASE INSPECTION CHECKLIST

Area Name and No.	Aircraft Serial No.	Date	Total Hrs. This Area
Fwd Radio/Battery Compartment 2			

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
1357	1. Equipment in nose compartment for security of attachment.				
15	2. Electrical wiring in nose compartment and behind instrument panel for chafing and security.				
1357	3. Electrical equipment shock mounts for deterioration, free throw, bottoming and security. Grounding straps or bands for damage and security.				
1	4. Heat/defog ducts and valves for damage and security.				
1357	5. Lines and hoses behind instrument panel for loose connections and chafing.				
1357	6. Pitot/static lines for absence of moisture.				

3

PHASE NO.________	Area Name and No. Fwd Radio/Battery Compartment 2	Aircraft Serial No.	Date

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	7. Battery connections for security and cleanliness.				
ALL	8. Battery removed, checked and serviced in battery shop (2408-18).				
1	9. Battery shelf for security and cleanliness.				
1	10. Attaching points and supporting structure for damage and cracks.				
ALL	11. Nose compartment interior clean and clear of loose objects or tools.				
EACH 50 HRS	12. Battery for leakage.				

4

PHASE NO.______

TM 55-1520-210-PI

PHASE INSPECTION CHECKLIST

Area Name and No.		Aircraft Serial No.		Date	Total Hrs. This Area
Cockpit Interior 3					

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
3	1. Crew door jettison mechanisms functionally checked. Hinge pins for wear, corrosion and distortion.				
37	2. Release cables for chafing, damage, and security.				
37	3. Door jettison handles properly wired with copper shearwire.				
ALL	4. Seal strips on crew doors for deterioration and delamination.				
37	5. Instrument lenses for cracks, looseness, slippage and cleanliness. Range markings for accuracy and legibility.				
37	6. Compass correction card in place and legible.				
ALL	7. Cyclic control stick for damage and proper operation.				

5

PHASE NO.________		Area Name and No. Cockpit Interior 3		Aircraft Serial No.		Date
Inspect Phase No's		Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	8.	Collective pitch control stick for correct minimum friction load.				
ALL	9.	Tail rotor pedal assemblies for corrosion, damage and proper operation.				
1357	10.	Windshield wiper motor cover guards for cracks and damage.				
1357	11.	Pilot and copilot seats for cuts, wear and security.				
37	12.	Seat adjustment mechanisms for wear, positive movement and locking.				
1357	13.	Armored seat quick releases for condition and security of copper shearwire.				
37	14.	Safety belts and shoulder harnesses for damage corrosion, cuts, fraying, and security. Check that time replacement dates have not been exceeded.				

6

PHASE NO.____	Area Name and No. Cockpit Interior 3		Aircraft Serial No.		Date
Inspect Phase No's	**Inspection Requirements**	**Status**	**Faults and/or Remarks**	**Action Taken**	**Initial**
1357	15. Inertia reels for positive locking and unlocking.				
37	16. Fire extinguisher for expiration date.				
37	17. Fire extinguisher and bracket for designated location, damage and security.				
37	18. Type A-20 fire extinguisher (if installed) for broken or missing seal and pressure indicator in green.				
37	19. Type CF3BR fire extinguisher (if installed) weighed with valve removed. Cylinder must be within 4 ounces of stenciled weight. Reassemble and reseal if acceptable.				
ALL	20. Mission equipment for security and properly stowed.				

7

PHASE NO.______	Area Name and No. Cockpit Interior 3		Aircraft Serial No.		Date
Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
37	21. Cockpit interior clean and clear of loose objects or tools.				
	Note: Some items in this area of the aircraft are included in the "power-on" requirements listed in the last section of the checklist.				

TM 55-1520-210-PI

PHASE INSPECTION CHECKLIST

PHASE NO.________

Area Name and No.		Aircraft Serial No.		Date	Total Hrs. This Area
Cabin Interior 4					

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
37	1. Cabin floor panels for cracks, dents, delamination and security.				
3	2. Cabin structure for damage, cracks, and corrosion (plates, panels, and doors opened for access).				
3	3. Pylon structure and access panels for cracks and damage.				
3	4. Soundproofing for cuts, tears, deterioration, and security.				
3	5. Stencils and decals for legibility.				
3	6. Passenger seats and lap belts (if installed) for wear, tears and security. Check that time replacement dates on lap belts have not been exceeded.				

PHASE NO.______	Area Name and No. Cabin Interior 4	Aircraft Serial No.	Date

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
37	7. First aid kits for designated location, presence of inspection date tag, broken or missing seal, and security. Side pocket contents for completeness. Identification markings for legibility.				
ALL	8. Mission equipment securely installed or stowed.				
37	9. Cabin interior clean and clear of loose objects or tools.				

10

PHASE NO.________

TM 55-1520-210-PI
PHASE INSPECTION CHECKLIST

Area Name and No.	Aircraft Serial No.	Date	Total Hrs. This Area
Under-Floor of Cockpit/Cabin 5			

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
3	1. Fuselage structure for damage, cracks and corrosion (floor panels removed for access).				
3	2. Area under floor for evidence of moisture accumulation. Drain holes for clogged condition.				
3	3. Collective friction liners for wear. Replace if shoes are less than 0.005 inch above rivets (TM 55-1520-210-35).				
ALL	4. Bearings, bushings and rod ends in flight control linkages for excessive play and security.				
1357	5. Flight control linkages, including push-pull tubes, links, bellcranks, idlers, levers, arms, jackshafts, etc., for corrosion, damage and security.				
37	6. Cyclic control force gradient assembly and magnetic brake for obvious damage, work linkage, and security.				

PHASE NO.________

Area Name and No. Under-Floor of Cockpit/Cabin 5

Aircraft Serial No.

Date

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
37	7. Tail rotor control force gradient assembly and magnetic brake for obvious damage, work linkage, and security.				
37	8. Throttle control linkage for damage, wear, and security.				
37	9. Electrical wiring for chafing, deterioration and security.				
3	10. Heater ducts, valves, and lines for security and damage.				
1357	11. Fuel supply lines for chafing, damage and leaks.				

12

PHASE NO.________

PHASE INSPECTION CHECKLIST

Area Name and No.	Aircraft Serial No.	Date	Total Hrs. This Area
Lower Pylon Area (Via Cabin Interior) 6			

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	1. Tail rotor drive quill for damage, leaks and security.				
ALL	2. Tail rotor drive shaft coupling for grease leakage.				
ALL	3. Tail rotor drive shaft clamp for security.				
EACH 500 HRS	4. Tail rotor drive shaft coupling disassembled and internal splines inspected and lubricated (2408-18).				
ALL	5. Transmission sump for oil level. Sight gages for damaged or stained glasses.				
1357	6. Transmission primary (internal) oil filter inspected and cleaned.				
EACH 300 HRS	7. Transmission oil pump screen inspected for contaminants and cleaned.				

PHASE NO. ________

Area Name and No. Lower Pylon Area (Via Cabin Interior) 6

Aircraft Serial No.

Date

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	8. Transmission electrical chip detector for metal accumulations and cleaned. Check for adequate residual magnetism.				
ALL	9. Transmission mount boots for cuts, tears, and deterioration.				
ALL	10. Resilient pylon mounts (5 each) for deterioration, cleanliness and security.				
15	11. Friction dampers (2 each) for proper operation, damage and security.				
15	12. Pylon mount structural supports (4 places) and fifth mount support fitting (1 each) visually for cracks and corrosion.				
ALL	13. Cyclic and collective cylinders for security and leaks.				
ALL	14. Hydraulic pump for leaks, damage and security. Pump and attaching lines for chafing and leaks.				

14

PHASE NO.________	Area Name and No. Lower Pylon Area (Via Cabin Interior) 6		Aircraft Serial No.		Date
Inspect Phase No's	**Inspection Requirements**	**Status**	**Faults and/or Remarks**	**Action Taken**	**Initial**
1357	15. Tachometer generator for damage and security.				
1357	16. Lift link for corrosion damage and security.				
5	17. Lift beam visually for cracks.				
15	18. Throttle control linkage for damage, wear and security.				
ALL	19. Hydraulic filter for appearance of red indicator button.				
ALL	20. Hydraulic filter paper element (P/N AN6235-2A) (if installed) replaced.				
EACH 1000 HRS	21. Hydraulic filter metal element (if installed) cleaned.				

PHASE NO.	Area Name and No. Lower Pylon Area (Via Cabin Interior) 6			Aircraft Serial No.	Date
Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
15	22. Electrical wiring for chafing and security of connections.				
	Note: Some items in this area of the aircraft are included in the "power-on" requirements listed in the last section of the checklist.				

PHASE NO.________

PHASE INSPECTION CHECKLIST

Area Name and No.	Aircraft Serial No.	Date	Total Hrs. This Area
Upper Pylon Area (Via Cabin Roof) 7			

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
1357	1. Hydraulic reservoir drain for water or other contamination (use sample jar). Hydraulic system and reservoir flushed if contaminants are evident.				
ALL	2. Hydraulic reservoir for fluid level. Reservoir filler cap sediment screen for condition and cleanliness.				
ALL	3. Hydraulic lines for security, damage, and leaks.				
37	4. Generator offset drive magnetic plug removed and visually checked for contaminants. Check for adequate residual magnetism.				
ALL	5. Generator electrical connections for security.				

PHASE NO.______	Area Name and No. Upper Pylon Area (Via Cabin Roof) 7			Aircraft Serial No.	Date	
Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken		Initial
ALL	6. Generator brushes for wear and freedom of movement in brush holder. Brush leads for deterioration and chafing. Commutator for evidence of arcing and presence of oil or metal particles.					
ALL	7. Main drive shaft for obvious damage, grease leakage and security. Clamps positioned such that bolts through one clamp set are 90 degrees to bolts through other clamp set.					
ALL	8. Main input drive shaft (P/N 204-040-010)(if installed) disassembled and coupling internal splines inspected and lubricated.					
EACH 600 HRS	9. Main input drive shaft (P/N 204-040-004)(if installed) disassembled and coupling internal splines inspected and lubricated.					

18

PHASE NO.______	Area Name and No. Upper Pylon Area (Via Cabin Roof) 7		Aircraft Serial No.		Date	
Inspect Phase No's	**Inspection Requirements**	**Status**	**Faults and/or Remarks**	**Action Taken**	**Initial**	
1357	10. Transmission oil lines and hoses for chafing, damage and leaks.					
ALL	11. Transmission housings, fittings and oil manifold for chafing, damage and leaks.					
ALL	12. Main input quill for damage, leaks and security.					

19

PHASE NO.________

TM 55-1520-210-PI
PHASE INSPECTION CHECKLIST

Area Name and No.	Aircraft Serial No.	Date	Total Hrs. This Area
Engine Air Induction Area 8			

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
15	1. Engine intake filters (3 sections) for damage, obstructions, and loose or missing fasteners. Gaps between filter sections not to exceed width of filter screen mesh.				
15	2. Air induction baffle assembly for chafing, cracks, dents, loose or missing fasteners, and security.				
15	3. FOD screen for foreign materials and damage which would permit passage of foreign material.				
ALL	4. Particle separator disassembled and inspected for clogging and damage. Gaskets and seals for cuts, deterioration and separation from backing plates.				
ALL	5. Separator filters (non-self-purging particle separator) cleaned and inspected for damage.				

20

PHASE NO.______	Area Name and No. Engine Air Induction Area 8		Aircraft Serial No.		Date
Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	6. Overboard discharge tube assembly (self-purging particle separator) for security. Remove accumulated residue.				
ALL	7. Flexible hoses (self-purging particle separator) for wear and security.				
ALL	8. Vortex tube cover removed, cleaned, and inspected for damage.				
15	9. Anti-icing probe (if installed) for obstructions and security.				
15	10. Electrical wiring for chafing and security of connections.				
ALL	11. Engine air inlet housing, inlet guide vanes and compressor blades for foreign object damage, erosion, dirt, varnish deposits and oil streaks. Clean as required.				

PHASE NO.________	Area Name and No. Engine Air Induction Area 8	Aircraft Serial No.	Date

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
1357	12. Variable inlet guide vane assembly for foreign objects and obvious damage (L-13).				
	Note: Some items in this area of the aircraft are included in the "power-on" requirements listed in the last section of the checklist.				

22

PHASE NO.________

TM 55-1520-210-PI

PHASE INSPECTION CHECKLIST

Area Name and No.		Aircraft Serial No.		Date	Total Hrs. This Area	
Main Rotor and Mast Area 9						
Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks		Action Taken	Initial
ALL	1. Main rotor blades for cracks, scratches, nicks, dents, erosion of leading edge, and evidence of bond failures.					
ALL	2. Main rotor hub, blade grips, pitch horns, and drag braces for visible damage, corrosion and security.					
ALL	3. Main rotor pillow block and grip reservoirs for oil level, leakage, and contamination.					
ALL	4. Main rotor pillow block reservoir sight glasses cleaned (interior surface) and reservoir flushed.					
1357	5. Main rotor grip reservoir sight glasses cleaned (interior surface) and reservoir flushed.					
ALL	6. Main rotor pitch links for excessive radial or axial play in bearings.					
ALL	7. Stabilizer bar and connecting linkage for nicks, scratches, dents and worn bearings or bushings.					

PHASE NO.________	Area Name and No. Main Rotor and Mast Area 9		Aircraft Serial No.		Date
Inspect Phase No's	**Inspection Requirements**	**Status**	**Faults and/or Remarks**	**Action Taken**	**Initial**
ALL	8. Stabilizer bar tube assembly for cracks and corrosion. Pay particular attention to inboard 5 inches where tube assembly attaches to stabilizer bar centerframe.				
ALL	9. Stabilizer dampers for full fluid level, wear and proper timing.				
ALL	10. Main rotor mast for corrosion, distortion, cracks and dents.				
ALL	11. Main rotor mast dust boot for deterioration and security.				
ALL	12. Collective sleeve drive plate for excessive play where engaged with main rotor mast splines.				
ALL	13. Scissors and sleeve assembly for visible damage and security. Bearings and bushings for excessive play.				

24

PHASE NO.______	Area Name and No. Main Rotor and Mast Area 9	Aircraft Serial No.	Date

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	14. Swashplate and support assembly for visible damage and security. Bearings and bushings for excessive play.				
ALL	15. Inner swashplate ring control lugs (3 each) for cracks. Load transfer devices and plates (P/N 204-011-458-1, -3, -5 or -7) do not need to be removed for this inspection.				
1357	16. Collective lever assembly for visible damage and security. Bearings and bushings for excessive play.				
1357	17. Collective and cyclic push-pull tubes for damage and security.				

PHASE NO.________

TM 55-1520-210-PI

PHASE INSPECTION CHECKLIST

Area Name and No.		Aircraft Serial No.		Date	Total Hrs. This Area
Cabin Roof Exterior 10					

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
1	1. Cabin roof for damage, skin cracks, tears and loose or missing rivets. Skin for buckled areas. Paint for chipped or peeling condition.				
ALL	2. Cabin roof windows for cracks, crazing and cleanliness.				
1	3. Cabin ventilator scoops for obstructions and damage.				
1357	4. Pitot tube and static ports for damage, obstruction, cleanliness, and absence of moisture.				

PHASE NO. ________	Area Name and No. Cabin Roof Exterior 10		Aircraft Serial No.		Date
Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
15	5. Transmission cowling for damage and security. Latches for proper operation.				
	Note: Some items in this area of the aircraft are included in the "power-on" requirements listed in the last section of the checklist.				

27

PHASE NO.________

PHASE INSPECTION CHECKLIST

Area Name and No.	Aircraft Serial No.	Date	Total Hrs. This Area
Cabin Ext Sides, Bottom & Landing Gear 11			

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	1. Crew doors for damage and positive latching. Windows for cracks, crazing, proper operation, and cleanliness.				
2468	2. Hinged cabin door for damage and positive latching. Hinges and door stops for wear and cracks. Windows for cracks, crazing and cleanliness.				
ALL	3. Cargo doors for damage and positive latching. Windows for cracks, crazing and cleanliness. Rollers and sliders for wear, damage, security, and proper operation.				
ALL	4. Cargo door tracks for wear and damage.				

PHASE NO.________		Area Name and No. Cabin Ext Sides, Bottom & Landing Gear 11		Aircraft Serial No.		Date
Inspect Phase No's		Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
2	5.	Cabin exterior for damage, skin cracks, tears and loose or missing rivets. Skin for buckled areas. Paint for chipped or peeling condition.				
2	6.	Stencils and decals on cabin exterior for legibility.				
2	7.	Hand holds and steps for cracks, corrosion and loose hardware. Step hinges for proper operation and security.				
ALL	8.	Fuel tank filler cap for condition and proper operation.				
26	9.	Exterior lights (navigation, landing and search) for damage and security.				
2	10.	Bottom of cabin exterior for cracks, buckles, wrinkles, and loose or missing rivets. Particular attention must be paid to landing gear cross tube attaching areas.				

PHASE NO.______	Area Name and No. Cabin Ext Sides, Bottom & Landing Gear 11	Aircraft Serial No.	Date

Inspect Phase No's		Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
2468	11.	Fuel tank sump drains for water or other contamination prior to test flight (use sample jar).				
2468	12.	Electrically driven fuel boost pumps visually for leaks, damage, and security.				
2468	13.	Break-away type valves (4 ea.) located at bottom of aft fuel cells, for chafing and cracks in breakable (necked) section. (Applies only to helicopters equipped with crashworthy fuel system.)				
ALL	14.	Landing gear cross tubes visually for cracks, obvious spread, damage and security.				
2	15.	Landing gear cross tubes for excessive spread. (Check by measurement).				
2	16.	Bumpers and fittings at cross tube-to-fuselage attach points for deterioration, cracks and security.				

30

PHASE NO.______	Area Name and No. Cabin Ext Sides, Bottom & Landing Gear 11	Aircraft Serial No.	Date

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
2468	17. Landing gear skid shoes for wear, damage and security.				
2468	18. Landing gear skid tubes, steps and end caps for cracks, damage and security.				
26	19. External stores support assembly beams (if installed) for fatigue cracks within 6 inches of upper fuselage attach points. Use dye penetrant, fluorescent penetrant or x-ray methods of inspection. (Applies to forward and aft beams on both sides of helicopter.)				

31

PHASE NO.______	Area Name and No. Cabin Ext Sides, Bottom & Landing Gear 11		Aircraft Serial No.		Date
Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	20. External stores installation (if installed) for condition and security. Bushings for wear.				
	Note: Some items in this area of the aircraft are included in the "power-on" requirements listed in the last section of the checklist.				

PHASE INSPECTION CHECKLIST

PHASE NO.________

Area Name and No.		Aircraft Serial No.		Date	Total Hrs. This Area	
Under Cabin Pylon Area (Hell Hole) 12						

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
1357	1. Fuel system components and associated lines and hoses for chafing, damage, leaks, and security.				
15	2. Fuel lines in area of transmission for 0.5 inch minimum clearance with transmission.				
1357	3. Transmission oil lines and hoses for chafing, damage and leaks.				
ALL	4. Transmission lower housing and fittings for chafing, damage and leaks.				
1357	5. Transmission sump drain for water or other contamination (use sample jar).				
EACH 300 HRS	6. Transmission oil drained and refilled.				
ALL	7. Transmission external oil filter for bypass condition.				

PHASE NO.______	Area Name and No. Under Cabin Pylon Area (Hell Hole) 12		Aircraft Serial No.		Date
Inspect Phase No's	**Inspection Requirements**	**Status**	**Faults and/or Remarks**	**Action Taken**	**Initial**
ALL	8. Transmission external oil filter element replaced.				
ALL	9. Cyclic and collective cylinders for proper clearance between servo valve and input lever and adjusting screw (if servo valve P/N 204-076-81A installed).				
ALL	10. Cyclic and collective cylinder retainer caps (P/N 100621 or P/N 100621-1) for looseness by a feel test. Tab washer tangs must be bent and in contact with flats on the retainers.				
ALL	11. Irreversible valves and connecting hydraulic lines for chafing, damage, security and leaks.				
ALL	12. Bearings, bushings and rod ends in flight control linkages for excessive play and security.				

PHASE NO.______	Area Name and No. Under Cabin Pylon Area (Hell Hole) 12		Aircraft Serial No.		Date	
Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial	
1357	13. Flight control linkages including push-pull tubes, bellcranks, idlers, etc. for corrosion, damage and security.					
15	14. Throttle control linkage for damage, wear and security.					
15	15. Electrical wiring for chafing and security of connection.					
1357	16. Cargo suspension assembly (if installed) for damage and security.					
15	17. Cargo hook manual release for proper operation. Release cable for wear.					

PHASE NO.______	Area Name and No. Under Cabin Pylon Area (Hell Hole) 12		Aircraft Serial No.		Date
Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	18. Cargo hook (non-swiveling type only) manually checked for swiveling motion indicating broken shear pin.				
	Note: Some items in this area of the aircraft are included in the "power-on" requirements listed in the last section of the checklist.				

36

PHASE NO.________

TM 55-1520-210-PI

PHASE INSPECTION CHECKLIST

Area Name and No.		Aircraft Serial No.		Date	Total Hrs. This Area
Mid Fuselage Under Engine Deck 13					

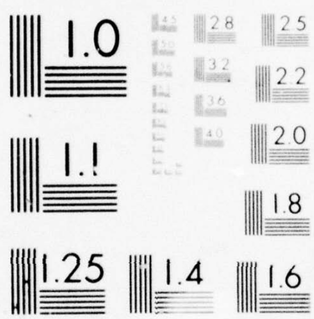
Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
2	1. Fuselage structure behind cabin and below engine deck for damage, cracks and corrosion (plates and panels removed for access).				
26	2. Throttle control linkage for damage, wear and security.				
26	3. Electrical wiring for chafing and security of connections.				
26	4. Flight idle solenoid for security.				

AD-A033 721 RCA GOVERNMENT AND COMMERCIAL SYSTEMS BURLINGTON MASS--ETC F/G 15/5
FIELD EVALUATION OF UH-1H HELICOPTER INSPECTION SYSTEMS. PROJEC--ETC(U)
NOV 76 F W HOHN, B B WIERENGA, J M BARDIS DAAJ02-74-C-0044

UNCLASSIFIED USAAMRDL-TR-76-27 NL

3 OF 3
AD
A033721

END
DATE
FILMED
2-77


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

PHASE NO.________

PHASE INSPECTION CHECKLIST

Area Name and No.	Aircraft Serial No.	Date	Total Hrs. This Area
Center Fuselage Exterior 14			

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
2	1. Center fuselage exterior for damage, skin cracks, and loose or missing rivets. Paint for chipped or peeling condition.				
ALL	2. Cargo door tracks for wear and damage.				
2468	3. Compartment doors (both sides of helicopter) for damage and positive latching. Hinges for wear and security.				
2468	4. External power receptacle door and caution light switch for damage and security.				

PHASE NO.________

TM 55-1520-210-PI

PHASE INSPECTION CHECKLIST

Area Name and No.		Aircraft Serial No.		Date	Total Hrs. This Area
Electronic/Comm. Compartments 15					

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
2468	1. Electrical equipment for obvious damage and security.				
26	2. Electrical wiring for chafing and security.				
26	3. Electrical equipment shock mounts for deterioration, free-throw, bottoming and security. Grounding straps or bands for damage and security.				
2	4. Fuselage structure for damage, cracks, and corrosion.				

PHASE NO.________

TM 55-1520-210-PI

PHASE INSPECTION CHECKLIST

Area Name and No.		Aircraft Serial No.		Date	Total Hrs. This Area
Engine Area Exterior 16					

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
26	1. Engine cowling and fairings for damage and security. Fasteners for condition and proper operation.				
26	2. Engine exhaust tailpipe for cracks, dents, and burned or buckled areas.				
2468	3. Engine second stage turbine blades, visually through tail-pipe, for cracks, burns, dents, and missing blades.				

40

PHASE NO.________

PHASE INSPECTION CHECKLIST

Area Name and No.		Aircraft Serial No.	Date	Total Hrs. This Area
Engine Compartment 17				

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
48	1. Engine air inlet housing for cracks, nicks, and corrosion particularly at fillets, flanges, and support pads.				
48	2. Accessory drive gearbox assembly for cracked flanges, seal leakage, and mounting security.				
ALL	3. Engine oil electrical chip detector for metal accumulations and cleaned. Check for adequate residual magnetism.				
48	4. Engine compressor housing for security, cracks, scratches, corrosion, and evidence of leakage.				
ALL	5. Engine oil strainers (at No. 2, No. 3, and No. 4 bearing housings) for metal particles before and after cleaning.				
48	6. Bleed air tubing for chafing and security.				
2468	7. Engine airbleed actuator strainer for condition and cleaned.				

PHASE NO.______ | Area Name and No. Engine Compartment 17 | Aircraft Serial No. | Date

Inspect Phase No's		Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
48	8.	Engine combustion chamber housing and exhaust diffuser for corrosion, cracks, dents, burned or buckled areas and evidence of leaks.				
48	9.	Fireshield for cracks, dents and security.				
ALL	10.	Starter-generator electrical connections for security.				
ALL	11.	Starter-generator brushes for wear and freedom of movement in brush holder. Brush leads for deterioration and chafing. Commutator for evidence of arcing and presence of oil or metal particles.				
48	12.	Overspeed governor, torque-meter boost pump, main oil pump and oil scavenge pump for leaks and security.				

42

PHASE NO.________	Area Name and No. Engine Compartment 17		Aircraft Serial No.		Date	
Inspect Phase No's	**Inspection Requirements**	**Status**	**Faults and/or Remarks**	**Action Taken**	**Initial**	
48	13. Overspeed governor and tachometer drive assembly for cracked flanges, seal leakage, and mounting security.					
2468	14. Gas producer tachometer generator for leaks and security.					
2468	15. Fuel regulator for leaks, damage and security.					
ALL	16. Fuel control inlet strainers inspected and cleaned.					
EACH 50 HRS	17. Fuel control servo filter replaced.					
ALL	18. Fuel control power lever for freedom of movement through full range to each stop.					
48	19. Throttle control linkage for damage, wear and security.					

PHASE NO.______		Area Name and No. Engine Compartment 17			Aircraft Serial No.	Date	
Inspect Phase No's		Inspection Requirements	Status	Faults and/or Remarks	Action Taken		Initial
2468	20.	Main and starting fuel manifolds for cracks, corrosion, leaks and security.					
2468	21.	Flow divider assembly for leaks, damage and security (L-13).					
ALL	22.	Main fuel filter micronic paper element inspected and replaced.					
ALL	23.	Fuel system lines and hoses for chafing, leaks and security.					
ALL	24.	Engine oil tank for oil level. Sight gages for damaged or stained glasses.					
ALL	25.	Engine oil tank for damage, security and leaks. Connecting lines for chafing, leaks and security.					
ALL	26.	Engine oil tank drained and refilled. Filler cap for security.					

PHASE NO.______		Area Name and No. Engine Compartment 17			Aircraft Serial No.	Date
Inspect Phase No's		Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	27.	Engine oil filter elements inspected and cleaned. Determine source of chips, if any found.				
ALL	28.	Oil system lines and hoses for chafing, leaks and security.				
ALL	29.	Hydraulic system lines for chafing, security, damage and evidence of leaks.				
48	30.	Engine electrical cable assemblies, exciter output leads assembly, and exhaust thermocouple assembly for cracks, chafing, and security.				
4	31.	Engine exhaust thermocouple assembly for continuity and correct read-outs using "Jetcal" analyzer (2408-18).				
ALL	32.	Fire detection elements for security. Attaching wires for cracks, chafing and security.				

45

PHASE NO.________		Area Name and No. Engine Compartment 17		Aircraft Serial No.		Date
Inspect Phase No's		Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	33.	Engine tubular mounts for damage, cracks, and security.				
ALL	34.	Engine mount rod ends for maximum allowable axial and radial play.				
2468	35.	Engine mount deck fittings for wear and security.				
ALL	36.	Engine mount pillow block assemblies for wear and damage. Trunnion caps for damage and security.				
ALL	37.	Tail rotor drive shafts for corrosion and damage. Clamps for security. Clamp bolted joints must be indexed 90 degrees to those of adjacent clamps.				
ALL	38.	No. 1 tail rotor drive shaft hanger bearing for wear, roughness, binding and overheat (shafts removed).				

46

PHASE NO.______		Area Name and No. Engine Compartment 17			Aircraft Serial No.	Date
Inspect Phase No's	Inspection Requirements		Status	Faults and/or Remarks	Action Taken	Initial
ALL	39.	No. 1 tail rotor drive shaft hanger assembly for damage and security. Coupling for grease leakage.				
EACH 500 HRS	40.	Tail rotor drive shaft coupling disassembled and internal splines inspected and lubricated (2408-18).				
2468	41.	Engine work platform decks for bonding separation, cracks, punctures and corrosion.				
2468	42.	Engine deck drain holes and channels for obstructions.				
	Note:	Some items in this area of the aircraft are included in the "power-on" requirements listed in the last section of the checklist.				

PHASE NO._______

TM 55-1520-210-PI
PHASE INSPECTION CHECKLIST

	Area Name and No.	Aircraft Serial No.		Date	Total Hrs. This Area	
	Tailboom Exterior 18					
Inspect Phase No's	**Inspection Requirements**	**Status**	**Faults and/or Remarks**	**Action Taken**		**Initial**
ALL	1. Tailboom and vertical fin for damage, skin cracks, corrosion, and loose or missing rivets. Paint for chipped or peeling condition.					
ALL	2. Tail rotor drive shaft covers for damage and security. Fasteners for positive locking.					
ALL	3. Gearbox access cowling for cracks, wear and security.					
ALL	4. Elevator assemblies for wear, corrosion and security.					
ALL	5. Tail skid for damage and security					
ALL	6. Ventral fin fairing for cracks, wear and security.					

PHASE NO.______	Area Name and No. Tailboom Exterior 18		Aircraft Serial No.		Date
Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	7. Whip antenna for damage and security.				

PHASE NO.________

PHASE INSPECTION CHECKLIST

Area Name and No.	Aircraft Serial No.	Date	Total Hrs. This Area
Tailboom Interior 19			

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	1. Tailboom structure, including longerons for corrosion, cracks and damage.				
ALL	2. Vertical fin forward spar (P/N 205-030-846) and vertical fin drive shaft cover attachment channel for cracks directly below gearbox attachment fitting (cover opened for access).				
ALL	3. Vertical fin rib (P/N 204-030-827) or (P/N 204-031-098) along rivet row at fin station 10.08 for cracks (access thru topmost lightening hole).				
26	4. Intermediate gearbox support fitting for cracks.				
ALL	5. Synchronized elevator support for corrosion and damage.				

PHASE NO.________	Area Name and No. Tailboom Interior 19		Aircraft Serial No.		Date
Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	6. Synchronized elevator control linkage for damage, binding, corrosion, and loose, missing, or improperly installed hardware.				
ALL	7. Bearings, bushings and rod ends in flight control linkages for excessive play and security.				
2468	8. Flight control linkages including push-pull tubes, links, bellcranks, idlers, quadrant, etc., for corrosion, damage and security.				
ALL	9. Tail rotor control cables for chafing, broken wires, and security.				
26	10. Tail rotor control cables for specified tension (TM 55-405-3)				

51

PHASE NO.______	Area Name and No. Tailboom Interior 19	Aircraft Serial No.	Date

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
26	11. Control cable pulleys for wear and damage.				
26	12. Electrical wiring for chafing and security of connections.				

52

PHASE NO.________

TM 55-1520-210-PI

PHASE INSPECTION CHECKLIST

Area Name and No.	Aircraft Serial No.	Date	Total Hrs. This Area
T.R. Drive Train Area 20			

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	1. Tail rotor drive shafts for corrosion and damage. Clamps for security. Clamp bolted joints must be indexed 90 degrees to those of adjacent clamps. Bolts for damage.				
ALL	2. Tail rotor drive shaft hanger bearings for wear, roughness, binding and overheat (shafts removed).				
ALL	3. Tail rotor drive shaft hanger assemblies for damage and security. Couplings for grease leakage.				
EACH 500 HRS.	4. Tail rotor drive shaft couplings disassembled and internal splines inspected and lubricated (2408-18).				
ALL	5. Intermediate gearbox for housing cracks, oil leaks and security.				
ALL	6. Intermediate gearbox for oil level. Sight gage for damaged or stained glass.				

PHASE NO.____	Area Name and No. T. R. Drive Train Area 20		Aircraft Serial No.		Date
Inspect Phase No's	**Inspection Requirements**	**Status**	**Faults and/or Remarks**	**Action Taken**	**Initial**
ALL	7. Intermediate gearbox oil drained and refilled.				
ALL	8. Intermediate gearbox electrical chip detector for metal accumulations and cleaned. Check for adequate residual magnetism.				
ALL	9. Intermediate gearbox vent for clogged condition.				
ALL	10. Tail rotor control aft cables for chafing, broken wires, and security.				
26	11. Control cable pulleys for wear and damage.				

54

PHASE NO.____

TM 55-1520-210-PI

PHASE INSPECTION CHECKLIST

Area Name and No. Tail Rotor and Gearbox Area 21

Aircraft Serial No. | **Date** | **Total Hrs. This Area**

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	1. Tail rotor gearbox for housing cracks, oil leaks and security.				
ALL	2. Tail rotor gearbox for oil level. Sight gage for damaged or stained glass.				
ALL	3. Tail rotor gearbox oil drained and refilled.				
ALL	4. Tail rotor gearbox electrical chip detector for metal accumulations and cleaned. Check for adequate residual magnetism.				
ALL	5. Tail rotor gearbox filler cap for clogged vent.				

PHASE NO.______	Area Name and No. Tail Rotor and Gearbox Area 21		Aircraft Serial No.		Date
Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
48	6. Tail rotor gearbox support fitting (casting) for cracks, corrosion, security and evidence of chafing by vertical fin door.				
ALL	7. Tail rotor control sprocket, chain and sprocket cover for cleanliness and security.				
48	8. Tail rotor control sprocket, and chain for wear. Sprocket for cracks (chain removed).				
ALL	9. Tail rotor control chain grommets for wear.				
ALL	10. Tail rotor control quill for nicks, corrosion, leakage and security.				
48	11. Tail rotor control quill for wear on splines which engage quill housing and on thread which engages control nut (pitch control assembly removed from gearbox)				

56

PHASE NO.______		Area Name and No. Tail Rotor and Gearbox Area 21		Aircraft Serial No.		Date
Inspect Phase No's		Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	12.	Tail rotor dust boot for deterioration and security.				
ALL	13.	Tail rotor blades for scratches, nicks, dents, erosion of leading edge, and evidence of bond failures.				
ALL	14.	Tail rotor hub assembly for visible damage and security.				
ALL	15.	Tail rotor yoke (detail of P/N 204-011-701 hub assembly) for cracks, utilizing magnetic particle inspection method.				
ALL	16.	Tail rotor control crosshead for excessive play.				
ALL	17.	Tail rotor pitch link rod end bearings for excessive play. Pitch change links for loose or broken rivets.				

PHASE NO.______		Area Name and No. Tail Rotor and Gearbox Area 21			Aircraft Serial No.	Date
Inspect Phase No's		Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	18.	Synthane washers between pitch change links and crosshead for condition.				
48	19.	Tail rotor assembly balanced and tracked.				
ALL	20.	Flapping motion of tail rotor for proper clearance between blade tips and tailboom fin.				

58

PHASE NO.________

PHASE INSPECTION CHECKLIST

Area Name and No.	Aircraft Serial No.	Date	Total Hrs. This Area
Oil Cooler/Aft Battery Compartment 22			

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
ALL	1. Oil coolers for obstructions, damage and security.				
48	2. Oil cooler blower screen, blower and duct for obstructions, damage and security.				
48	3. Fan blades for cracks.				
48	4. Blower drive, bleed air line for damage and security.				
8	5. Blower supporting structure for damage, cracks and security.				
ALL	6. Tail rotor control hydraulic components and connecting lines for damage, leaks and security. Hydraulic piston wiped clean.				

PHASE NO.______	Area Name and No. Oil Cooler/Aft Battery Compartment 22			Aircraft Serial No.		Date
Inspect Phase No's	**Inspection Requirements**	**Status**	**Faults and/or Remarks**	**Action Taken**	**Initial**	
ALL	7. Bearings, bushings and rod ends in flight control linkages for excessive play and security.					
2468	8. Flight control linkages, including push-pull tubes, links, bellcranks, etc., for corrosion, damage and security.					
48	9. Electrical wiring for chafing and security of connections.					
ALL	10. Tailboom attach bolt torque stripes (slippage marks) for evidence of movement.					
ALL	11. Tailboom attachment fittings for cracks and wear.					
2468	12. Rigid connecting link (P/N 205-030-249-3) for proper installation.					
48	13. Rigid connecting link attaching points and supporting structure for damage and cracks.					

60

PHASE NO. ______	Area Name and No. Oil Cooler/Aft Battery Compartment 22			Aircraft Serial No.	Date	
Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial	
ALL	14. Battery connections for security and cleanliness.					
ALL	15. Battery removed, checked and serviced in battery shop (2408-18).					
8	16. Battery shelf for security and cleanliness					
8	17. Attaching points and supporting structure for damage and cracks.					
EACH 50 HRS.	18. Battery for leakage.					
	NOTE: Some items in this area of the aircraft are included in the "Power-on" requirements listed in the last section of the checklist.					

61

PHASE NO.______

PHASE INSPECTION CHECKLIST

Area Name and No.		Aircraft Serial No.		Date	Total Hrs. This Area
Heater Compartment Area 23					

Inspect Phase No's	Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
8	1. Fuselage structure for damage, cracks, and corrosion.				
48	2. Electric wiring for chafing and security of connections.				
8	3. Combustion heater (if installed) and associated lines, hoses and ducts for damage, leaks, and security.				

PHASE NO.______

PHASE INSPECTION CHECKLIST

Area Name and No.	Aircraft Serial No.	Date	Total Hrs. This Area
Power On Checks			

Inspect Phase No's		Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
3	3-22	Interior lights (dome, cockpit, instrument, console, and pedestal lights) for proper operation.				
ALL	3-23	Caution panel lights for illumination with test switch in test position.				
37	3-24	Fuel quantity indicator checked with test switch.				
ALL	6-23	Chip detector warning lights for illumination with chip detectors shorted.				
ALL	8-13	Particle separator overboard vent for smooth flow during engine operation. Smooth flow indicates sand ejector operating satisfactorily.				
15	10-6	Pitot heater for proper operation.				

PHASE NO.______	Area Name and No. Power On Checks		Aircraft Serial No.		Date
Inspect Phase No's	**Inspection Requirements**	**Status**	**Faults and/or Remarks**	**Action Taken**	**Initial**
26	11-21 Exterior lights (navigation, anti-collision, tail, landing and search lights) for proper operation.				
ALL	12-19 Cyclic and collective cylinders and connecting hydraulic lines for leaks.				
15	12-20 Cargo hook electrical release for proper operation.(if installed)				
ALL	17-43 Main fuel filter for clogged element condition. Check via cockpit warning light indication with fuel boost pumps on.				
ALL	17-44 Engine for unusual noises that might indicate binding. Check by rotating engine with starter with ignition off (prior to engine run-up). Do not exceed 40 seconds continuous smooth operation.				

PHASE NO. ________		Area Name and No. Power On Checks		Aircraft Serial No.		Date	
Inspect Phase No's		Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial	
2468	17-45	Fuel control emergency system solenoid valve operationally checked during ground run-up.					
ALL	17-46	Engine controls for free action through full range during engine operation. Idle stop release and governor RPM actuator functionally checked.					
ALL	17-47	Engine bleed air valve and actuator for proper operation.					
48	17-48	Engine bleed air lines for leaks					
4	17-49	Heater bleed air valve for proper operation.					
ALL	17-50	Fuel lines for leaks during engine operation.					

PHASE NO.______	Area Name and No. Power On Checks	Aircraft Serial No.	Date

Inspect Phase No's		Inspection Requirements	Status	Faults and/or Remarks	Action Taken	Initial
48	17-51	Combustion chamber drain valve for:				
		no fuel draining overboard during engine operation.				
		fuel draining overboard during engine coastdown or after shutdown.				
48	22-19	Oil cooler blower fan blades cleaned using hose and water while fan is operating. (Do not remove blower screen.)				

APPENDIX B

CONFIDENCE METHODOLOGY, CALCULATIONS AND RESULTS

In addition to soliciting comments from field operational personnel as to the practicality and acceptability of the phased inspection system, a statistical analysis was made to determine if the phased inspection schedule was superior to the intermediate/periodic (PMI, PMP) schedule. Confidence calculations were performed after all field data was gathered testing the variables OR and MMH/FH to determine if the field test was statistically successful. This appendix reports on the methodology used, the calculations made and the results achieved.

CONFIDENCE METHODOLOGY

The methodology used was to analyze MMH/FH and OR data for all 120 data points (aircraft) gathered during the test. It consisted of two basic steps:

1. Preparatory analysis estimating the mean ($\overline{X}$) and standard deviation (σ) to eliminate extraneous data points (hanger queens, etc.).

2. Calculations to determine whether the average of one group exceeds the average of the other group and the confidence level for each field result tested. This was based on the analysis of measurement data procedure provided in the engineering design handbook AMCP706-110*.

Preparatory Analysis and Calculations

The raw data for the analysis was provided by the Data Management System. Figures B-1 through B-6 present the input data used on a company basis. Note that only the variables MMH PER FLT-HR (last column) and OR PERCENT (second column) were tested. Thus, with the six companies, 120 data points (60 test and 60 control were used for each variable in the analysis.

---

*Engineering Design Handbook AMCP706-110, Experimental Statistics, Section 1, Basic Concepts and Analysis of Measurement Data, AMC Pamphlet, Headquarters, U.S. Army Materiel Command, December 1969.

MONTHLY EVALUATION CRITERIA RESULTS FOR AIRCRAFT IN A PARTICULAR COMPANY PAGE 37

RESULTS FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR B-COMPANY: 101ST AVN BN-TEST COMPANY, UH1-H HELICOPTERS AT FORT CAMPBELL, KENTUCKY

AIRCRAFT PROGRAM ID #	OR PERCENT	NORS PERCENT	NORM PERCENT	RMC PERCENT	AVERAGE UTIL FLT-HRS PER MO	R M PERCENT	R F PERCENT	MMH PER NORM	MMH PER FLT-HR
1101	75.0	2.6	22.5	39.6	17.9	96.5	96.9	0.42	3.88
1102	73.0	14.0	13.1	20.4	21.9	96.5	99.2	1.33	6.17
1103	75.2	7.7	17.1	13.0	21.3	97.8	98.5	0.46	2.71
1104	84.9	5.4	9.7	41.6	26.1	97.7	98.1	1.25	3.41
1105	75.8	11.8	12.4	68.5	20.1	99.6	100.0	0.87	3.92
1106	87.0	5.6	6.4	18.1	23.9	97.8	98.7	1.98	3.87
1107	83.8	2.9	13.2	13.8	21.4	99.6	99.6	0.98	4.42
1108	75.1	17.4	7.5	11.4	21.5	98.9	99.6	1.49	3.82
1109	79.8	9.5	10.7	21.1	19.5	99.2	99.6	0.98	3.94
1110	59.0	24.7	16.3	25.5	15.3	98.4	98.4	0.56	4.42
1111	62.0	20.1	16.9	19.6	21.1	97.2	98.4	0.66	3.88
1112	65.4	1.7	25.5	10.5	10.1	98.2	99.1	0.45	8.33
1113	84.6	6.2	5.0	24.5	21.1	97.7	99.6	2.48	4.32
1114	73.3	5.6	18.0	7.4	18.7	97.1	97.5	0.62	4.38
1115	75.6	8.4	16.0	35.3	19.7	98.2	99.1	0.60	3.58
1116	75.2	0.8	24.0	19.9	20.9	99.1	100.0	0.35	2.95
1117	67.4	18.0	14.6	39.1	23.1	98.6	98.9	1.13	5.19
1118	81.5	6.4	12.2	18.1	21.5	98.7	98.7	0.95	3.91
1119	88.9	3.4	7.7	20.4	28.3	99.0	99.7	1.30	2.59
1120	72.9	11.4	15.7	71.3	21.1	99.7	99.7	0.88	4.86

Figure B-1. Confidence Calculation Data Points, B Company, 101st BN.

MONTHLY EVALUATION CRITERIA RESULTS FOR AIRCRAFT IN A PARTICULAR COMPANY PAGE 38

RESULTS FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR D-COMPANY; 101ST AVN BN-TEST COMPANY, UH1-H HELICOPTERS AT FORT CAMPBELL, KENTUCKY

AIRCRAFT PROGRAM ID #	OR PERCENT	NORS PERCENT	NORM PERCENT	RMC PERCENT	AVERAGE UTIL FLT-HRS PER MO	R M PERCENT	R F PERCENT	MMH PER NORM	MMH PER FLT-HR
1201	73.1	2.4	14.8	58.4	19.5	98.9	98.9	0.81	4.52
1202	72.4	3.5	24.1	15.8	22.7	99.3	99.3	0.54	4.23
1203	70.2	8.8	13.6	25.6	18.7	98.8	99.2	0.60	3.23
1204	86.8	3.0	10.1	11.4	30.4	99.7	99.7	1.27	3.10
1205	81.8	0.5	16.0	32.0	22.5	99.0	99.7	0.75	3.93
1206	62.1	29.2	8.7	28.3	14.4	98.5	99.0	1.43	6.31
1207	88.0	0.1	11.9	53.3	25.1	99.1	100.0	0.75	2.60
1208	72.3	6.4	21.3	26.0	20.7	97.6	98.0	0.57	4.33
1209	78.5	2.6	18.9	28.7	16.6	97.2	97.7	0.55	4.60
1210	58.7	10.7	24.9	41.0	14.1	100.0	100.0	0.38	4.96
1211	76.0	9.4	12.4	7.9	24.3	98.7	98.7	0.79	2.95
1212	66.7	9.6	22.8	17.9	21.7	98.4	99.6	0.63	4.84
1213	57.1	1.4	27.4	18.3	20.1	98.3	98.3	0.48	4.16
1214	80.1	2.3	17.6	37.2	15.6	99.5	99.5	0.58	4.80
1215	78.6	6.8	14.2	21.3	18.3	98.3	98.3	0.80	4.54
1216	75.4	0.0	18.5	9.4	15.9	100.0	100.0	0.91	6.03
1217	88.1	1.2	10.7	39.6	26.6	99.1	99.1	1.30	3.77
1218	90.2	1.5	8.4	5.6	26.9	98.9	99.6	1.59	3.65
1219	76.9	4.5	18.5	33.1	25.8	100.0	100.0	0.82	4.32
1220	84.6	1.9	13.4	5.5	25.1	99.3	99.7	0.52	2.02

Figure B-2. Confidence Calculation Data Points, D Company, 101st BN.

MONTHLY EVALUATION CRITERIA RESULTS FOR AIRCRAFT IN A PARTICULAR COMPANY PAGE 39

RESULTS FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR D-COMPANY; 158TH AVN BN-TEST COMPANY, UH1-H HELICOPTERS AT FORT CAMPBELL, KENTUCKY

AIRCRAFT PROGRAM ID #	OR PERCENT	NORS PERCENT	NORM PERCENT	RMC PERCENT	AVERAGE UTIL FLT-HRS PER MO	R M PERCENT	R F PERCENT	MMH PER NORM	MMH PER FLT-HR
1301	82.6	7.4	10.0	35.7	19.1	99.5	100.0	1.01	3.88
1302	55.7	14.6	26.6	28.1	12.5	98.2	98.2	0.39	6.18
1303	80.1	0.7	19.3	40.1	19.6	99.2	99.2	0.78	5.64
1304	58.1	12.5	1[illegible].9	27.0	20.8	95.9	97.4	0.95	6.31
1305	86.3	1.8	9.2	34.9	23.7	97.9	98.3	1.53	4.37
1306	70.6	1.6	27.7	21.8	17.3	99.0	99.0	0.52	5.66
1307	80.4	1.6	13.3	11.4	20.3	97.0	98.3	0.87	4.41
1308	69.5	6.5	22.7	5.2	22.2	95.3	96.4	0.64	4.80
1309	75.9	1.0	20.6	20.1	20.2	98.1	99.2	0.61	4.59
1310	82.0	2.9	15.2	10.3	31.1	98.6	98.6	1.42	5.08
1311	81.0	2.6	7.3	18.1	24.9	98.3	99.0	2.02	4.33
1312	73.8	2.8	16.7	22.5	21.1	97.9	98.6	1.12	6.47
1313	82.5	5.2	12.2	19.4	22.7	98.2	98.6	1.29	5.09
1314	86.2	0.2	12.3	19.3	23.8	98.4	99.4	1.42	5.41
1315	89.2	1.8	9.1	40.2	26.3	98.3	99.3	1.78	4.52
1316	83.5	1.5	15.0	12.9	27.1	98.9	99.3	0.98	3.98
1317	81.8	5.9	12.3	13.9	28.0	97.9	98.6	1.09	3.48
1318	87.3	1.3	11.0	11.2	29.2	98.7	99.0	1.49	4.12
1319	85.5	0.4	13.2	32.8	24.6	98.8	99.1	1.39	5.44
1320	85.3	1.0	13.7	10.4	24.8	98.0	98.8	1.10	4.46

Figure B-3. Confidence Calculation Data Points, D Company, 158th BN.

MONTHLY EVALUATION CRITERIA RESULTS FOR AIRCRAFT IN A PARTICULAR COMPANY PAGE 40

RESULTS FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR C-COMPANY; 101ST AVN BN-CONTROL COMPANY. UH1-H HELICOPTERS AT FORT CAMPBELL, KENTUCKY

AIRCRAFT PROGRAM ID #	OR PERCENT	NORS PERCENT	NORM PERCENT	RMC PERCENT	AVERAGE UTIL FLT-HRS PER MO	R M PERCENT	R F PERCENT	MMH PER NORM	MMH PER FLT-HR
2101	78.0	8.8	13.2	4.8	22.0	98.0	98.0	1.13	5.02
2102	69.7	7.8	14.0	22.3	18.7	99.6	100.0	0.89	4.89
2103	84.9	0.1	14.5	10.5	18.4	99.1	99.5	1.05	6.05
2104	68.8	12.5	14.4	2.6	16.9	98.3	99.5	0.83	5.17
2105	64.0	28.2	7.8	8.2	20.7	97.1	100.0	1.43	4.20
2106	66.4	7.9	10.8	24.2	15.4	98.2	98.8	1.30	6.70
2107	84.3	6.1	9.6	1.0	19.0	98.0	99.0	1.22	4.49
2108	63.9	15.2	16.7	7.8	19.9	98.6	99.1	0.75	4.62
2109	74.5	5.5	20.1	0.0	19.7	99.2	99.2	0.66	5.00
2110	58.2	15.2	13.8	12.0	15.3	97.8	98.9	0.84	5.52
2111	70.3	14.1	15.6	9.1	14.7	98.4	99.0	0.48	3.74
2112	77.9	16.5	5.3	0.1	17.1	98.3	99.4	2.10	4.44
2113	68.7	10.7	20.6	19.1	18.9	97.8	98.7	0.62	4.92
2114	71.9	3.1	25.0	0.0	21.5	97.4	99.1	0.53	4.52
2115	54.2	31.4	14.4	5.7	17.9	98.6	98.6	0.70	4.13
2116	78.6	11.9	9.5	2.6	27.5	99.3	100.0	1.48	3.76
2117	80.6	7.7	11.7	5.0	20.7	98.3	99.1	1.31	5.47
2118	78.2	6.9	14.9	0.0	26.5	99.3	99.3	0.82	3.41
2119	84.4	3.3	12.3	6.2	23.9	98.8	99.2	0.90	3.38
2120	92.6	0.0	7.4	20.1	26.6	98.2	99.7	1.44	2.92

Figure B-4. Confidence Calculation Data Points, C Company 101st BN.

MONTHLY EVALUATION CRITERIA RESULTS FOR AIRCRAFT IN A PARTICULAR COMPANY PAGE 41

RESULTS FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR B-COMPANY; 158TH AVN BN-CONTROL COMPANY. UH1-H HELICOPTERS AT FORT CAMPBELL. KENTUCKY

AIRCRAFT PROGRAM ID #	OR PERCENT	NORS PERCENT	NORM PERCENT	RMC PERCENT	AVERAGE UTIL FLT-HRS PER MO	R M PERCENT	R F PERCENT	MMH PER NORM	MMH PER FLT-HR
2201	59.7	11.5	20.2	2.1	19.7	97.6	98.6	0.66	4.92
2202	84.7	2.2	13.0	4.8	23.5	98.9	99.3	1.13	4.60
2203	61.9	5.0	9.6	4.8	12.1	98.5	99.3	0.95	5.54
2204	81.6	3.3	12.1	8.1	18.1	99.1	99.1	1.42	6.98
2205	81.9	2.8	15.3	17.3	24.4	98.9	98.9	1.44	6.59
2206	94.4	0.0	4.7	0.0	29.1	98.8	100.0	4.46	5.23
2207	81.9	9.2	9.0	24.2	21.3	99.6	100.0	1.59	4.92
2208	86.4	5.5	8.1	21.4	21.7	99.3	99.7	1.98	5.44
2209	56.3	17.3	20.6	8.1	13.7	99.4	99.4	0.86	9.45
2210	79.9	5.4	11.7	30.5	19.7	99.1	99.5	1.43	5.81
2211	86.8	2.7	10.5	37.1	21.7	98.4	98.8	1.57	5.60
2212	80.1	7.6	12.3	4.5	24.2	98.8	99.1	1.42	5.30
2213	62.0	24.3	13.3	4.4	21.9	98.9	99.6	1.17	5.22
2214	80.3	6.4	11.9	11.2	21.8	99.2	99.6	1.22	4.88
2215	79.6	3.2	16.8	15.5	18.8	98.7	99.6	0.48	3.18
2216	81.1	1.6	17.1	0.0	22.5	98.7	99.6	1.09	6.08
2217	79.8	9.6	8.6	1.5	28.8	98.5	99.1	3.27	7.14
2218	88.9	0.3	10.8	4.4	29.7	98.4	99.0	1.54	4.09
2219	87.7	0.0	12.3	4.4	31.8	99.3	100.0	1.13	3.17
2220	77.6	1.5	20.8	19.6	25.6	98.7	98.7	0.50	2.98

Figure B-5. Confidence Calculation Data Points, B Company 158th BN.

MONTHLY EVALUATION CRITERIA RESULTS FOR AIRCRAFT IN A PARTICULAR COMPANY PAGE 42

RESULTS FOR REPORT PERIOD BEGINNING 08/21/74 AND ENDING 11/20/75

FOR C-COMPANY; 158TH AVN BN-CONTROL COMPANY. UH1-H HELICOPTERS AT FORT CAMPBELL. KENTUCKY

AIRCRAFT PROGRAM ID #	OR PERCENT	NORS PERCENT	NORM PERCENT	RMC PERCENT	AVERAGE UTIL FLT-HRS PER MO	R N PERCENT	R F PERCENT	MMH PER NORM	MMH PER FLT-HR
2301	67.1	25.2	7.8	6.3	12.6	100.0	100.0	1.46	6.59
2302	63.3	18.7	16.2	2.2	23.0	97.7	98.1	0.76	3.91
2303	75.7	12.9	6.3	8.5	12.3	98.3	99.4	1.98	7.48
2304	78.0	1.1	20.9	1.8	15.7	98.4	98.4	0.69	6.70
2305	85.7	5.3	8.2	4.8	24.2	98.7	99.3	1.97	4.89
2306	63.2	13.8	21.9	0.0	21.6	99.1	99.1	0.95	7.08
2307	79.1	9.4	11.5	3.3	19.7	98.4	98.4	1.37	5.85
2308	78.1	7.9	14.0	3.3	20.6	96.8	98.0	0.98	4.85
2309	60.3	25.8	11.5	0.0	19.4	97.7	98.1	1.27	5.52
2310	77.2	3.8	14.6	7.2	14.7	98.8	98.8	0.73	5.37
2311	70.8	17.5	10.4	4.6	19.9	99.1	100.0	1.55	5.93
2312	75.1	13.6	8.1	0.7	20.8	100.0	100.0	2.31	6.59
2313	65.6	14.7	18.8	0.0	21.1	96.9	99.6	0.78	5.10
2314	79.2	8.1	12.7	6.6	19.5	98.7	99.1	1.07	5.12
2315	87.7	6.3	5.9	0.7	25.3	99.4	99.4	2.16	3.71
2316	73.0	10.3	16.7	0.0	19.1	99.0	99.5	0.82	5.29
2317	81.8	6.1	12.0	7.0	21.5	99.0	99.7	0.95	3.90
2318	84.6	10.3	5.1	1.3	28.7	99.1	99.4	2.89	3.80
2319	83.5	4.4	12.1	0.7	23.1	98.7	99.3	1.27	4.87
2320	79.5	3.1	17.4	4.2	23.1	99.0	99.3	0.66	3.63

Figure B-6. Confidence Calculation Data Points, C Company, 158th BN.

The preparatory analysis performed was designed to locate data points which were more than two standard deviations away from the mean. Once these data points were found they were deleted from the analysis. A small computer program was written to perform this analysis. A listing of the program is provided in Figure B-7. Input to the program was the aircraft program ID No. and the variable to be tested, either MMH/FH or OR. Example output of the program is provided in Figures B-8 through B-13. These figures illustrate the initial use of the program, one for each company. To explain the output printout and the analysis procedure, Figure B-8 will be discussed.

Figure B-8 consists of four columns of numbers. Column 1 lists the aircraft ID numbers followed by the total number, in this case 20. Column 2 is the input value of MMH/FH for each aircraft followed by the computed mean ($\overline{X}$) for all. Column 3, labeled 1, is the error value or the value minus the mean. It is followed by the sum of column 3, the sum of the errors, a very small number. Column 4, labeled 2, is column 3 squared. The total of this column can be written as

$$\sum_{i=1}^{n} (X_i - \overline{X})^2$$

which is the sample estimate of variance (s^2) multiplied by n-1 as is noted on page 1-10 of AMCP706-110. To determine which data points are the extraneous ones, the analyst must first compute the standard deviation, double the value (2σ), and compare it with the values of column 3. If the absolute vaue of any values in column 3 exceeds the 2σ value, they are discarded. Note that this is a repetitive process; once the calculations are made and some data points removed, the calculations are made again to determine if the 2σ value is exceeded in the smaller data set. Using the example of Figure B-8, the 2σ value is computed as follows:

As noted earlier the sum of column 3, 30.5534 equals -

$$30.5534 = \sum_{i=1}^{n} (X_i - \overline{X})^2 = s^2 \ (n-1) = \sum e^2$$

```
MAV1   3/31/76                                              PAGE: 1

0010 DIM I$[13],B[2],F$[80],V[4]
0020 INPUT "INPUT FILE:",I$
0030 OPEN FILE[1,3],I$
0032 OPEN FILE[0,1],"$LPT"
0035 INPUT "J=",J
0040 LET N=0
0045 LET S=0
0050 INPUT FILE[1],A,B[1],B[2];
0060 IF EOF(1) THEN GOTO 0200
0070 LET N=N+1
0080 LET S=S+B[J]
0090 GOTO 0050
0200 PRINT "POINTS=";N
0210 LET M=S/N
0220 PRINT "MEAN  =";M
0230 CLOSE FILE[1]
0240 OPEN FILE[1,3],I$
0250 FOR I=1 TO 4
0260   LET V[I]=0
0270 NEXT I
0280 PRINT FILE[0]," ID     VALUE        1                 2                 3"
0290 LET F$="####   ##.####  -##.######    ####.####    -#####.###   ######.
0300 INPUT FILE[1],A,B[1],B[2];
0310 IF EOF(1) THEN GOTO 0500
0320 LET D=B[J]-M
0330 LET V[1]=V[1]+D
0340 LET V[2]=V[2]+D*D
0350 LET V[3]=V[3]+D*D*D
0355 LET V[4]=V[4]+D*D*D*D
0360 PRINT FILE[0],USING F$,A,B[J],D,D*D,D*D*D,D*D*D*D
0390 GOTO 0300
0500 PRINT FILE[0],""
0510 PRINT FILE[0],USING F$,N,M,V[1],V[2],V[3],V[4]
0515 PRINT FILE[0]," "
0520 PRINT FILE[0],,,,SQR(V[2]/N),SQR(V[2]/(N*N))
0530 CLOSE FILE[1]
0540 CLOSE FILE[0]
0590 GOTO 0020
```

Figure B-7. Preparatory Analysis Computer Program Listing.

```
INPUT FILE:TEST1
J=2
POINTS= 20                                  ERROR            ERROR SQUARED
MEAN   = 4,2275
ID                  VALUE                   1                2
 1101                3,88                   -,347501          ,120757
 1102                6,17                    1,9425          3,7733
 1103                2,71                   -1,5175          2,30281
 1104                3,41                   -,817501          ,668308
 1105                3,92                   -,307501         9,45567E-2
 1106                3,87                   -,357501          ,127807
 1107                4,42                    ,192499         3,70559E-2
 1108                3,82                   -,407501          ,166057
 1109                3,94                   -,287501          ,082657
 1110                4,42                    ,192499         3,70559E-2
 1111                3,88                   -,347501          ,120757
 1112                8,33                  * 4,1025          16,8305
 1113                4,32                    9,24988E-2      8,55602E-3
 1114                4,38                    ,152499          ,023256
 1115                3,58                   -,647501          ,419258
 1116                2,95                   -1,2775          1,63201
 1117                5,19                    ,962499          ,926404
 1118                3,91                   -,317501          ,100807
 1119                2,59                   -1,6375          2,68141
 1120                4,86                    ,632499          ,400055

 20                  4,2275                 -2,00272E-5      30,5534
```

Figure B-8. Initial Preparatory Analysis Program Output for MMH/FH, B Company 101st BN.

```
INPUT FILE:TEST2
J=2
POINTS= 20                                  ERROR            ERROR SQUARED
MEAN   = 4,1445
ID                  VALUE                   1                2
 1201                4,52                    ,3755            ,141
 1202                4,23                    8,54988E-2      7,31005E-3
 1203                3,23                   -,914501          ,836312
 1204                3,1                    -1,0445          1,09098
 1205                3,93                   -,2145           4,60104E-2
 1206                6,31                  * 2,1655          4,68939
 1207                2,6                    -1,5445          2,38548
 1208                4,33                    ,185499          ,03441
 1209                4,6                     ,4555            ,20748
 1210                4,96                    ,815499          ,665039
 1211                2,95                   -1,1945          1,42683
 1212                4,84                    ,695499          ,483719
 1213                4,16                    1,54991E-2      2,40223E-4
 1214                4,8                     ,655499          ,42968
 1215                4,54                    ,395499          ,15642
 1216                6,03                    1,8855          3,55511
 1217                3,77                   -,3745            ,14025
 1218                3,65                   -,494501          ,244531
 1219                4,32                    ,175499         3,07999E-2
 1220                2,02                  *-2,1245          4,5135

 20                  4,1445                 -1,33514E-5      21,0845
```

Figure B-9. Initial Preparatory Analysis Program Output for MMH/FH, D Company 101st BN.

INPUT FILE:TEST3
J=2
POINTS= 20
MEAN = 4,911

ID	VALUE	ERROR 1	ERROR SQUARED 2
1301	3,88	-1,031	1,06296
1302	6,18	1,269	1,61036
1303	5,64	,729	,531441
1304	6,31	1,399	1,9572
1305	4,37	-,541	,292681
1306	5,66	,749	,561
1307	4,41	-,501	,251001
1308	4,8	-,111	,012321
1309	4,59	-,321	,103041
1310	5,08	,169	2,85609E-2
1311	4,33	-,581	,337561
1312	6,47	1,559	2,43048
1313	5,09	,179	,032041
1314	5,41	,499	,249001
1315	4,52	-,391	,152881
1316	3,98	-,931001	,866762
1317	3,48	-1,431	2,04776
1318	4,12	-,791	,625682
1319	5,44	,528999	,27984
1320	4,46	-,451	,203401
20	4,911	-4,76837E-6	13,636

Figure B-10. Initial Preparatory Analysis Program Output for MMH/FH, D Company 158th BN.

INPUT FILE:CONT1
J=2
POINTS= 20
MEAN = 4,6175

ID	VALUE	ERROR 1	ERROR SQUARED 2
2101	5,02	,402499	,162006
2102	4,89	,272499	7,42558E-2
2103	6,05	1,4325	2,05205
2104	5,17	,552499	,305255
2105	4,2	-,417501	,174307
2106	6,7	* 2,0825	4,3368
2107	4,49	-,127501	1,62566E-2
2108	4,62	2,49863E-3	6,24313E-6
2109	5	,382499	,146305
2110	5,52	,902499	,814505
2111	3,74	-,877501	,770009
2112	4,44	-,177502	3,15068E-2
2113	4,92	,302499	9,15055E-2
2114	4,52	-9,75008E-2	9,5064E-3
2115	4,13	-,487501	,237657
2116	3,76	-,857501	,735308
2117	5,47	,852499	,726755
2118	3,41	-1,2075	1,45806
2119	3,38	-1,2375	1,53141
2120	2,92	-1,6975	2,88151
20	4,6175	-2,38419E-5	16,555

Figure B-11. Initial Preparatory Analysis Program Output for MMH/FH, C Company 101st BN.

```
INPUT FILE:CONT2
J=2
POINTS= 20
MEAN  = 5.356
```

ID	VALUE	ERROR 1	ERROR SQUARED 2
2201	4.92	-.436	.190096
2202	4.6	-.756	.571535
2203	5.54	.184	.033856
2204	6.98	1.624	2.63737
2205	6.59	1.234	1.52276
2206	5.23	-.126	1.58761E-2
2207	4.92	-.436	.190096
2208	5.44	8.39996E-2	7.05594E-3
2209	9.45	* 4.094	16.7608
2210	5.81	.454	.206116
2211	5.6	.244	5.95362E-2
2212	5.3	-5.59998E-2	3.13597E-3
2213	5.22	-.136	1.84959E-2
2214	4.88	-.476	.226576
2215	3.18	-2.176	4.73497
2216	6.08	.724	.524176
2217	7.14	1.784	3.18266
2218	4.09	-1.266	1.60276
2219	3.17	-2.186	4.77859
2220	2.98	-2.376	5.64538
20	5.356	1.90735E-6	42.9119

Figure B-12. Initial Preparatory Analysis Program Output for MMH/FH, B Company 158th BN.

```
INPUT FILE:CONT3
J=2
POINTS= 20
MEAN  = 5.309
```

ID	VALUE	ERROR 1	ERROR SQUARED 2
2301	6.59	1.281	1.64096
2302	3.91	-1.399	1.9572
2303	7.48	* 2.171	4.71324
2304	6.7	1.391	1.93488
2305	4.89	-.419	.175561
2306	7.08	1.771	3.13644
2307	5.85	.541	.292681
2308	4.85	-.459	.210681
2309	5.52	.211	4.45212E-2
2310	5.37	6.09999E-2	3.72098E-3
2311	5.93	.621	.385641
2312	6.59	1.281	1.64096
2313	5.1	-.209	4.36808E-2
2314	5.12	-.189	.035721
2315	3.71	-1.599	2.5568
2316	5.29	-1.90001E-2	3.61002E-4
2317	3.9	-1.409	1.98528
2318	3.8	-1.509	2.27708
2319	4.87	-.439	.192721
2320	3.63	-1.679	2.81904
20	5.309	9.53674E-7	26.0472

Figure B-13. Initial Preparatory Analysis Program Output for MMH/FH, C Company 158th BN.

Therefore s, or approximate σ equals -

$$\sigma \approx s = \sqrt{\frac{\sum_{i=1}^{n} (X_i - \bar{X})^2}{n-1}} = \sqrt{\frac{30.5534}{19}} = 1.2681$$

$$2\sigma = 2.5362$$

Note that ID No. 1112's absolute error exceeds the 2σ value and was removed from the analysis. This fact is denoted by an asterisk. Similarly, the 2σ analysis was performed on the other companies and is similarly indicated in Figures B-9 through B-13.

The initial preparatory analysis was performed for each company for both variables tested, MMH/FH and OR. The parameters calculated were company sample size (n), mean ($\bar{X}$), and sample estimate of variance multiplied by n-1 or $\sum e^2$. Table B-1 provides the summary values.

TABLE B-1. COMPANY SUMMARY ANALYSIS DATA.

	MMH/FH			OR		
Company	n	$\bar{X}$	$\sum e^2$	n	$\bar{X}$	$\sum e^2$
B-101st BN	18	3.8917	7.9194	19	76.8895	1042.94
D-101st BN	18	4.1422	11.8815	17	78.8059	768.63
D-158th BN	20	4.9110	13.6360	18	81.3056	531.25
C-101st BN	19	4.5079	11.9899	17	74.4176	795.41
B-158th BN	18	5.2606	20.3417	16	83.2938	298.63
C-158th BN	19	5.1947	21.0859	18	76.1667	984.28

The first three companies listed in Table B-1 compose the test group while the last three compose the control group. Note for the variable MMH/FH that the mean value for D/158 is significantly different than the others in the test group. Similarly in the control group, C/101's mean value for MMH/FH is significantly different from the rest of the control group. This was the first indication that maintenance work was performed/reported differently between battalions and that the test group versus control group samples might not be statistically the best sample to use as was originally planned.

Confidence Calculation Methodology

The confidence procedure used relied on the design handbook text AMCP706-110. The procedure is described in Paragraph 3-3, Case 2, Subparagraph 3-3.2.2. Briefly, the test is to determine whether "the average of material, product or process A exceeds that of material, product, or process B". In our case, we wanted to determine if the MMH/FH of the control group was higher than the test group and whether the OR of the test group was higher than the control group. Case 2 was selected which states: "The variability in performance of each of A and B is unknown, and it is not reasonable to assume that they both have the same variability."

AMCP706-110 specifies the following procedure for this case:

1. Choose α, the significance level of the test.

2. Compute: $\bar{X}_A$ and S_A^2, $\bar{X}_B$ and S_B^2, from the n_A and n_B measurements from A and B.

3. Compute:

$$V_A = \frac{S_A^2}{n_A}$$

and

$$V_B = \frac{S_B^2}{n_B},$$

the estimated variances of $\bar{X}_A$ and $\bar{X}_B$, respectively.

4. Compute the "effective number of degrees of freedom"

$$f = \frac{(V_A + V_B)^2}{\frac{V_A^2}{n_A + 1} + \frac{V_B^2}{n_B + 1}} - 2$$

5. Look up $t_{1-\alpha}$ for f' degrees of freedom in Table A-4, where f' is the integer nearest to f; denote this value by $t'_{1-\alpha}$.

6. Computer

$$u = t'_{1-\alpha}\sqrt{V_A + V_B}$$

7. If $(\bar{X}_A - \bar{X}_B) > u$, decide that the average of A exceeds the average of B; otherwise, decide that there is no reason to believe that the average of A exceeds the average of B.

8. Let m_A and m_B be the true averages of A and B. Note that the interval from $\{(\bar{X}_A - \bar{X}_B) - u\}$ to ∞ is approximately a one-sided 100 $(1 - \alpha)$% confidence interval estimate of the true difference $(m_A - m_B)$.

Table A-4 is found in AMCP706-114* and is reproduced below.

TABLE B-2. PERCENTILES OF THE t DISTRIBUTION.

df	$t_{.60}$	$t_{.70}$	$t_{.80}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$
1	.325	.727	1.376	3.078	6.314	12.706	31.821	63.657
2	.289	.617	1.061	1.886	2.920	4.303	6.965	9.925
3	.277	.584	.978	1.638	2.353	3.182	4.541	5.841
4	.271	.569	.941	1.533	2.132	2.776	3.747	4.604
5	.267	.559	.920	1.476	2.015	2.571	3.365	4.032
6	.265	.553	.906	1.440	1.943	2.447	3.143	3.707
7	.263	.549	.896	1.415	1.895	2.365	2.998	3.499
8	.262	.546	.889	1.397	1.860	2.306	2.896	3.355
9	.261	.543	.883	1.383	1.833	2.262	2.821	3.250
10	.260	.542	.879	1.372	1.812	2.228	2.764	3.169
11	.260	.540	.876	1.363	1.796	2.201	2.718	3.106
12	.259	.539	.873	1.356	1.782	2.179	2.681	3.055
13	.259	.538	.870	1.350	1.771	2.160	2.650	3.012
14	.258	.537	.868	1.345	1.761	2.145	2.624	2.977
15	.258	.536	.866	1.341	1.753	2.131	2.602	2.947
16	.258	.535	.865	1.337	1.746	2.120	2.583	2.921
17	.257	.534	.863	1.333	1.740	2.110	2.567	2.898
18	.257	.534	.862	1.330	1.734	2.101	2.552	2.878
19	.257	.533	.861	1.328	1.729	2.093	2.539	2.861
20	.257	.533	.860	1.325	1.725	2.086	2.528	2.845
21	.257	.532	.859	1.323	1.721	2.080	2.518	2.831
22	.256	.532	.858	1.321	1.717	2.074	2.508	2.819
23	.256	.532	.858	1.319	1.714	2.069	2.500	2.807
24	.256	.531	.857	1.318	1.711	2.064	2.492	2.797
25	.256	.531	.856	1.316	1.708	2.060	2.485	2.787
26	.256	.531	.856	1.315	1.706	2.056	2.479	2.779
27	.256	.531	.855	1.314	1.703	2.052	2.473	2.771
28	.256	.530	.855	1.313	1.701	2.048	2.467	2.763
29	.256	.530	.854	1.311	1.699	2.045	2.462	2.756
30	.256	.530	.854	1.310	1.697	2.042	2.457	2.750
40	.255	.529	.851	1.303	1.684	2.021	2.423	2.704
60	.254	.527	.848	1.296	1.671	2.000	2.390	2.660
120	.254	.526	.845	1.289	1.658	1.980	2.358	2.617
∞	.253	.524	.842	1.282	1.645	1.960	2.326	2.576

*Engineering Design Handbook AMCP706-114, Experimental Statistics, Section 5, Tables, AMC Pamphlet, Headquarters, U.S. Army Materiel Command, December 1969.

The significance level of the test, α, was specified as 0.05. However, the confidence sought in the evaluation results was 80 percent as stated in the estimate of required flying hours (36,000) provided in the Project Inspect Phase II Proposal. The problem was to determine the confidence achieved by testing the two variables and seeing if the 80 percent level was met or exceeded. The above procedure was used in a slightly modified form to make it simple to determine if the significance level of the test was met. The modification entailed combining steps 6 and 7 as follows:

$$(\overline{X}_A - \overline{X}_B) > u = t'_{1-\alpha} \sqrt{V_A + V_B}$$

Dividing both sides by $\sqrt{V_A + V_B} \triangleq S$.

(the definition of S)

$$T \triangleq \frac{(\overline{X}_A - \overline{X}_B)}{V_A + V_B} > t'_{1-\alpha}$$

(definition of T)

For $\alpha = 0.05$ and most values of f, $t'_{1-\alpha}$ is approximately 1.65 to 1.7. Thus, if T is greater than this, the test is passed with greater than 95 percent confidence. T can be thought of as the number of standard deviations the two sample means are apart.

To recap:

With this modification we need to compute $\overline{X}$ for each sample to be compared, calculate the effective number of degrees of freedom (f), calculate S, and calculate T. If T exceeds the value 1.65, the test has passed.

The calculations for f and S were also performed on the computer. Figure B-14 is the listing for that program. When run, it prints out six values as follows:

$$\left.\begin{array}{ll} S1 & = \sum e^2, \text{ Sample 1} \\ N1 & = \text{ Sample 1 Size} \\ S2 & = \sum e^2, \text{ Sample 2} \\ N2 & = \text{ Sample 2 Size} \end{array}\right\} \text{Inputs}$$

$$\left.\begin{array}{ll} S & = \sqrt{V_A + V_B} \\ f & = \text{ Degrees of Freedom} \end{array}\right\} \text{Outputs}$$

```
0005 REM 4/1/76 "SF"
0030 OPEN FILE[0,1],"$LPT"
0100 INPUT "S1,N1:",S1,N1
0150 PRINT FILE[0],"S1=";S1
0160 PRINT FILE[0],"N1=";N1
0200 INPUT "S2,N2:",S2,N2
0250 PRINT FILE[0],"S2=";S2
0260 PRINT FILE[0],"N2=";N2
0300 LET V1=S1/(N1*(N1-1))
0310 LET V2=S2/(N2*(N2-1))
0320 LET S=SQR(V1+V2)
0330 PRINT FILE[0],"S=";S
0340 LET F=(V1+V2)^2/(V1*V1/(N1+1)+V2*V2/(N2+1))-2
0350 PRINT FILE[0],"F=";F
0360 PRINT S,F
0370 PRINT FILE[0]
```

Figure B-14. Confidence Calculation Program.

<u>CALCULATION RESULTS</u>

Initially, it was desired to perform confidence calculations on the test versus control group variables MMH/FH and OR. The procedure to do this is:

1. Perform preparatory analysis on the two samples to be compared. (Determine $\overline{X}$, $\sum e^2$, n)

2. Perform confidence calculations (Determine f and S)

3. Calculate T and compare with 1.6.

This procedure was followed for the test versus control group and the results are depicted below:

TEST GROUP	MMH/FH	CONTROL GROUP
$\overline{X}$ = 4.3363	f = 109.5	$\overline{X}$ = 4.9829
$\sum e^2$ = 44.2792	S = 0.184	$\sum e^2$ = 59.9447
n = 56	T = 3.51	n = 56

TEST GROUP	OR	CONTROL GROUP
$\overline{X}$ = 78.9648	f = 104	$\overline{X}$ = 77.8196
$\sum e^2$ = 2523.70	S = 1.4	$\sum e^2$ = 2803.70
n = 54	T = 0.82	n = 51

Note that the MMH/FH group test passes but the OR group test does not. This led to further analysis of the input means on a company basis. The hypothesis was made that the companies in the groups could be from different populations. To test this out, tests of the same type were made between companies in the same group but in different battalions. These are indicated below as the vertical comparisons for MMH/FH.

TEST SAMPLES		CONTROL SAMPLES
B&D/101BN $\overline{X}$ = 4.0169 $\sum e^2$ = 20.3660 n = 36	f = 36.3 S = 0.226 T = 2.17	C/101BN $\overline{X}$ = 4.5079 $\sum e^2$ = 11.9899 n = 19
f = 37.6 S = 0.228 T = 3.92	MMH/FH	f = 48.4 S = 0.257 T = 2.80
D/158BN $\overline{X}$ = 4.9110 $\sum e^2$ = 13.6360 n = 20	f = 49.7 S = 0.259 T = 1.21	B&C/158 BN $\overline{X}$ = 5.2268 $\sum e^2$ = 41.4676 n = 37

The resulting significance proved that the companies in the same group but from different battalions were indeed from different populations for the variable MMH/FH. Similarly the same tests were made for the variable OR and the results are depicted below:

TEST SAMPLES		CONTROL SAMPLES
B&D/101BN $\overline{X}$ = 77.7944 $\sum e^2$ = 1844.5200 n = 36	f = 34.1 S = 2.09 T = 1.62	C/101BN $\overline{X}$ = 74.4176 $\sum e^2$ = 795.4050 n = 17
f = 45.3 S = 1.79 T = 1.96	OR	f = 34.6 S = 2.11 T = 2.42
D/158BN $\overline{X}$ = 81.3056 $\sum e^2$ = 531.2490 n = 18	f = 45.3 S = 1.81 T = 0.99	B&C/158 BN $\overline{X}$ = 79.5206 $\sum e^2$ = 1713.1700 n = 34

The same significance again resulted. It is apparent then that separate samples should be used for the confidence test other than the original test and control groups. In other words, it makes more sense statistically to compare test versus control companies within the same battalion. This led to the analysis of two test versus two control samples. The battalion confidence calculation results are given on the four box diagrams underneath the horizontal connecting lines. Note that both variables OR and MMH/FH for the 158th BN, the T = 1.65 criterion was not met. That meant the one sided 95 percent confidence interval estimate of the true difference between the averages for the methods was not obtained. However, a lessor confidence interval estimate is associated with the T numbers indicated. These may be determined by referring to Table A-4 and interpolating the confidence interval estimate (the t subscript number). To do this accurately, a graph of the t distribution was made. (t subscript versus tabular value for constant degree of freedom.) Confidence level values were then obtained from the use of the graph and are given in Table 15 of the main text. Note all exceed the original projection of 80 percent.

APPENDIX C

OR AND MMH/FH BATTALION DATA

This appendix presents OR and MMH/FH data for the two battalions participating in the field evaluation at Fort Campbell. The data has been reorganized from that in the main body of the report to provide visibility to the confidence results.

Confidence calculations (Appendix B) showed that the test versus control group samples studied at length during the field test did not have the proper qualifications from a statistical viewpoint to be considered as a sample indicative of the total UH-1H fleet. Appendix B showed that there is a high confidence that the two battalions are from completely different populations. That analysis recommended that the confidence estimate for the field results be confined to battalion comparisons as is shown in Table 15. Each battalion was divided in test and control samples as follows:

	Test Sample	Control Sample
101st BN	B&D Companies	C Company
158th BN	D Company	B&C Companies

For analysis purposes, each of these samples can be looked at in terms of OR and MMH/FH data. Tables C-1 and C-2 present that data for each sample as it was gathered and summed cumulatively by the Data Management System. Interested parties may want to compare these tables with Table 7 (OR) and Table 6 (MMH/FH)of the main report. The MMH/FH data is also presented in graphical form in Figures C-1 (101st BN) and C-2 (158th BN). The data shown is cumulative monthly which is slow to show a true trend once the data bank has been biased in one direction. Both Figures illustrate differing behavior over the first few months of the program. This probably reflects different data recording practices in each battalion and non-uniform data gathering as compared with the requirements of Project Inspect. It wasn't until the fifth month of the program that a Data Recording Guide was issued to all participating troops. This started a learning cycle through weekly class instruction and OJT in uniform Project Inspect data recording. That this training was successful, is amply illustrated in both figures in the smoothing out of the curves.

TABLE C-1. 101ST BATTALION SAMPLE TEST/CONTROL CUMULATIVE STATUS (OR PERCENT) AND MAINTENANCE RESULTS (MMH/FH).

	TEST SAMPLE B&D COMPANIES		CONTROL SAMPLE C COMPANY	
MONTH	OR	MAINT RATIO	OR	MAINT. RATIO
1	77.60	3.125	81.30	3.470
2	77.70	4.460	79.40	3.900
3	77.25	4.435	74.60	3.700
4	78.30	5.175	75.80	3.930
5	79.85	5.245	77.20	4.080
6	79.90	5.020	76.40	3.940
7	79.30	5.215	76.00	4.190
8	78.90	4.715	75.70	4.210
9	78.35	4.660	75.40	4.800
10	77.80	4.460	76.10	4.900
11	77.45	4.315	75.70	4.650
12	77.55	4.310	73.40	4.710
13	77.10	4.265	73.20	4.830
14	76.50	4.130	73.60	4.710
15	75.85	4.040	73.40	4.520

TABLE C-2. 158TH BATTALION SAMPLE TEST/CONTROL CUMULATIVE STATUS (OR PERCENT) AND MAINTENANCE RESULTS (MMH/FH).

	TEST SAMPLE D COMPANY		CONTROL SAMPLE B&C COMPANIES	
MONTH	OR	MAINT. RATIO	OR	MAINT. RATIO
1	78.90	4.950	73.85	5.245
2	79.60	4.070	72.40	6.185
3	80.90	5.250	72.75	5.610
4	81.60	5.410	72.80	5.695
5	81.70	5.910	74.90	6.335
6	81.70	6.000	76.55	6.100
7	82.70	6.180	77.50	5.885
8	83.30	5.920	78.65	5.795
9	83.10	5.710	77.60	5.375
10	82.50	5.330	76.60	5.455
11	82.70	5.000	76.45	5.450
12	82.40	5.040	76.95	5.390
13	81.60	4.930	76.75	5.340
14	80.30	4.900	76.90	5.205
15	78.80	4.830	77.00	5.185

The OR data presented in Tables C-1 and C-2 is difficult to interpret because it is "goal" oriented, not related to true availability, and highly affected by operational conditions (remote exercises, aircraft shortages, maintenance backlogs, etc.). However, broad trends can be analyzed and reasons for them sought as was discussed in the main report. Figure 22 of the main report presented test and control group data in monthly increments rather than cumulatively as is given in Tables C-1 and C-2. Similarly, Figures C-3 and C-4 illustrate battalion OR monthly data. These figures amplify the group curves shown in Figure 22 as they are given on a company basis. Two deviations from the typical operational "zig-zags" warrant explanation. The first is the C Company, 101st BN very low OR in month 12. The second is the sharp

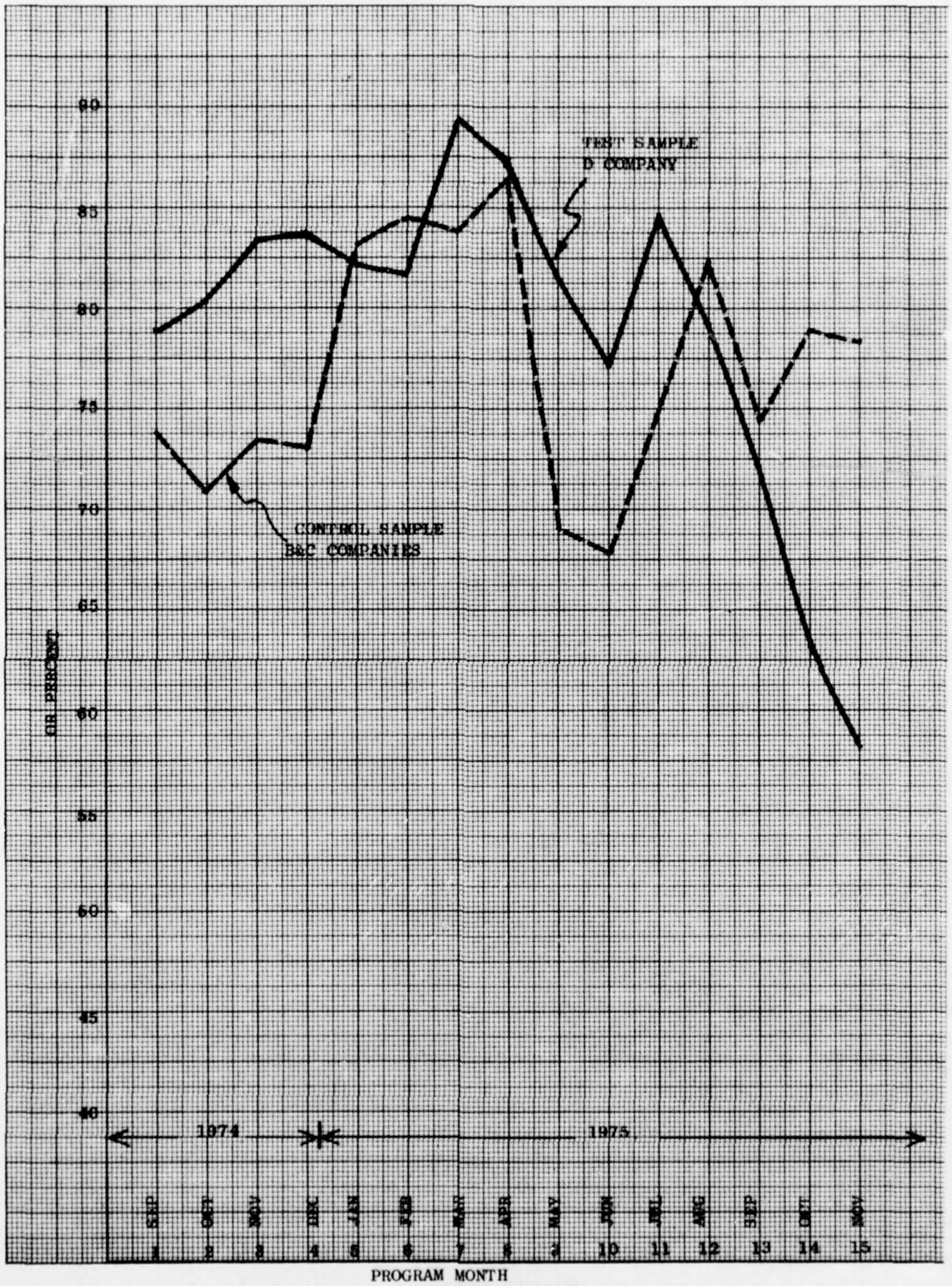


Figure C-1. 101st Battalion Cumulative Maintenance Results.

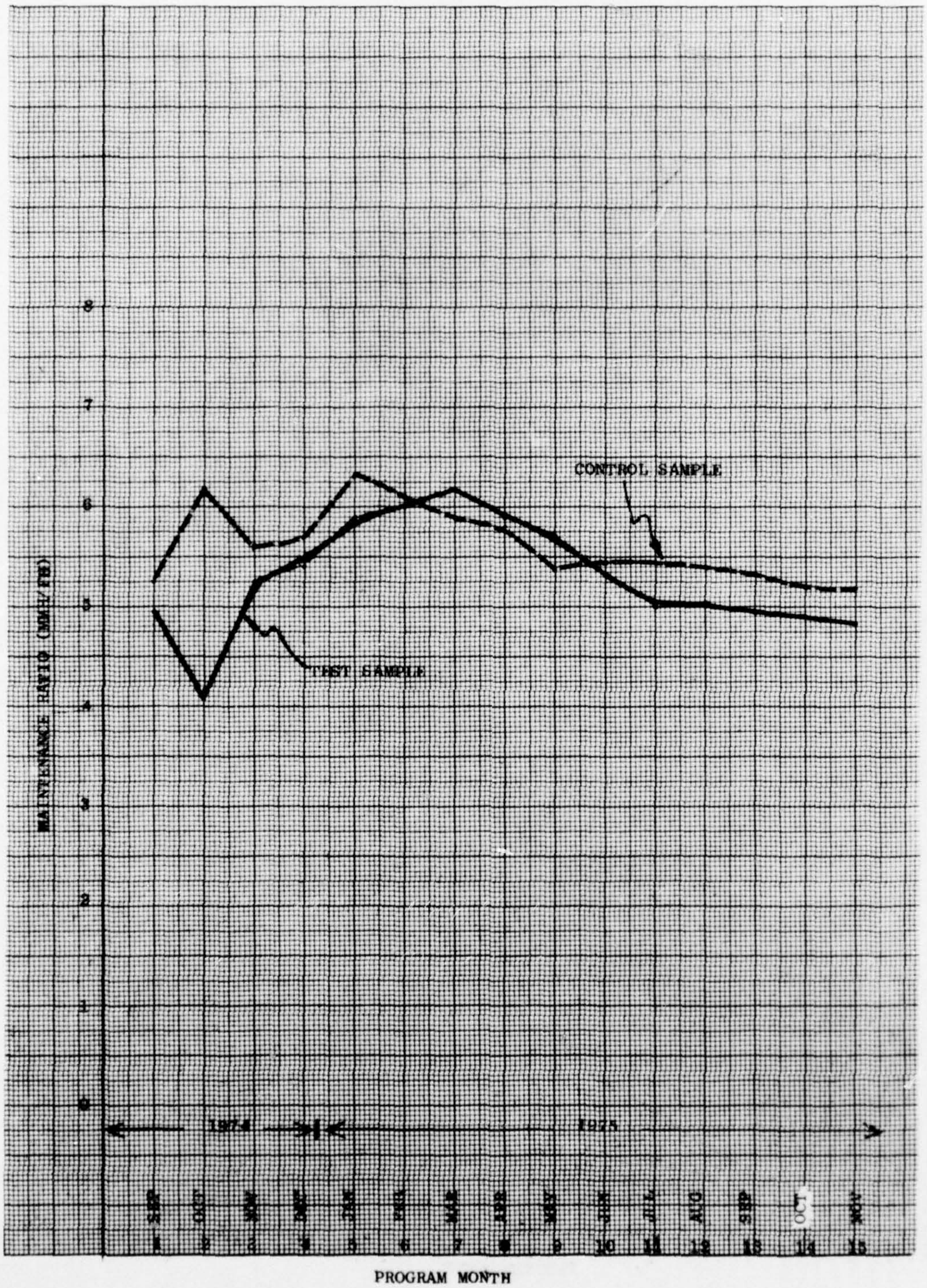


Figure C-2. 158th Battalion Cumulative Maintenance Results.

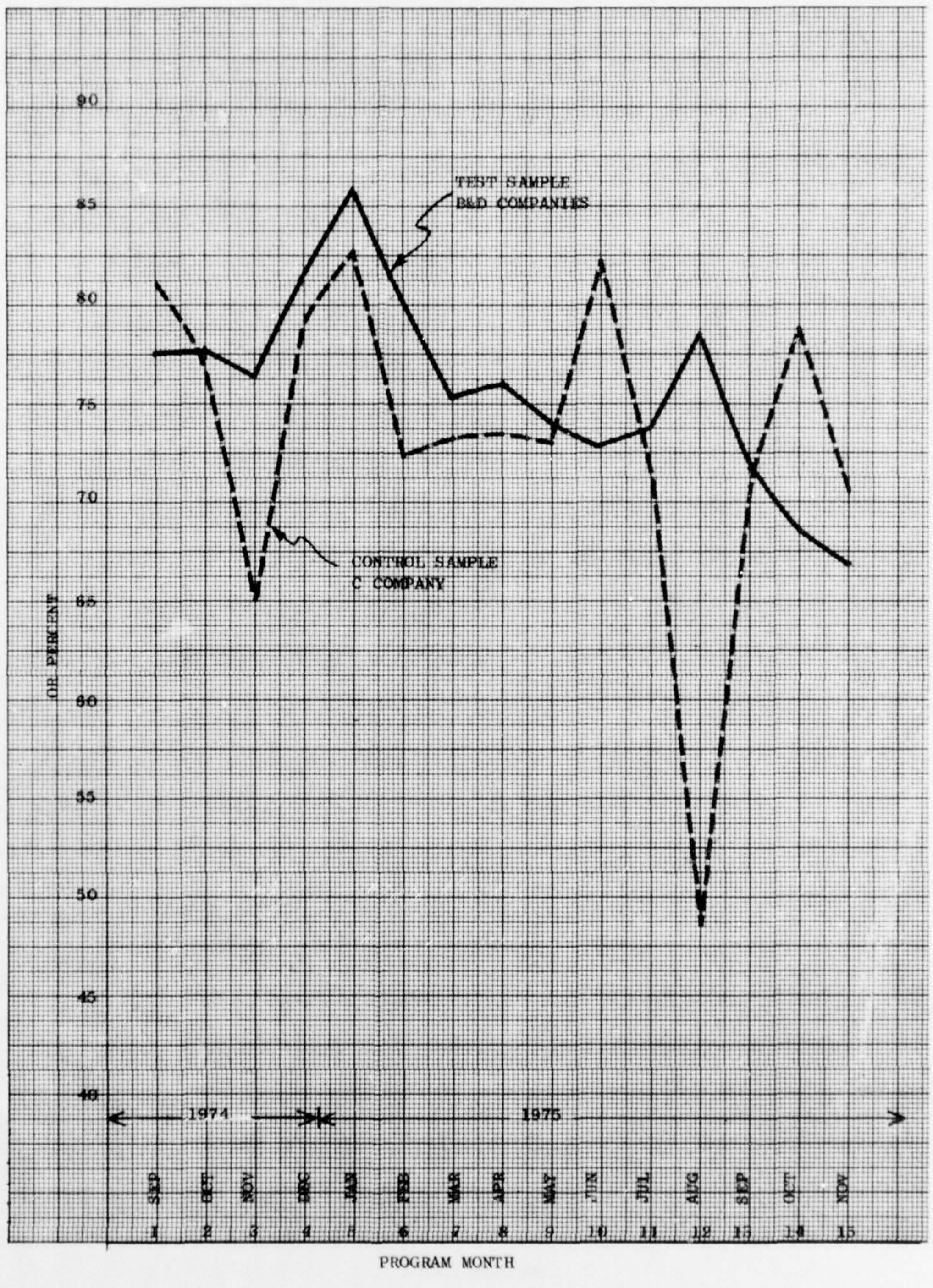


Figure C-3. 101st Battalion Monthly Operational Readiness Results.

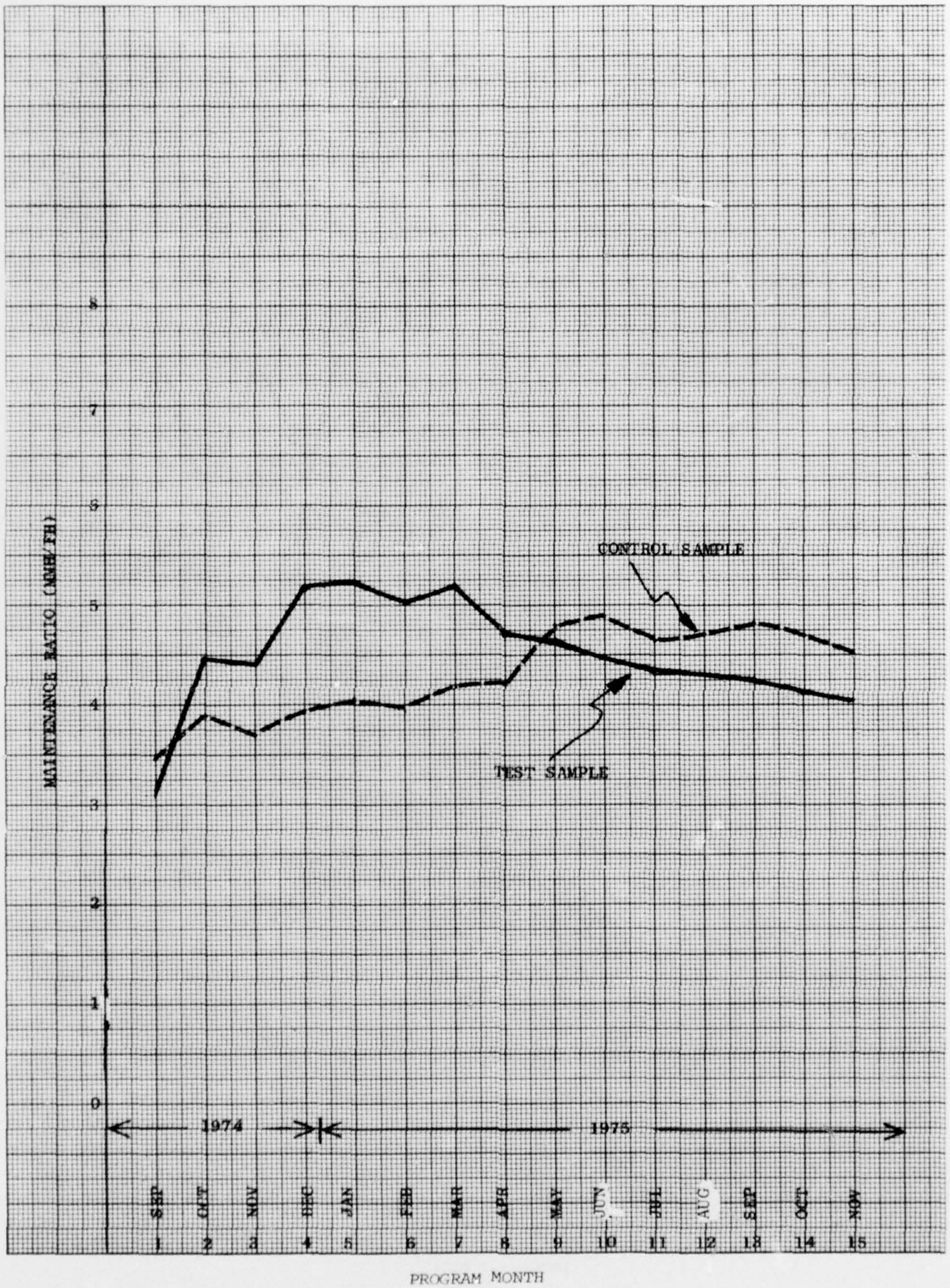


Figure C-4. 158th Battalion Monthly Operational Readiness Results.

declining trend of OR in D Company, 158th BN during the last three months of the program.

In month 12 of the program, C Company, 101st BN reported extensive NORM time on 15 of their 20 aircraft. A commanders note on the 1352 form stated: "Excessive NORM time due to critical lack of experience in flight and service platoon and many maintenance man-hours lost due to parades, parade practice and preparation for the annual I.G. inspection".

Excessive NORM time is also given as the reason for low OR during the last three months by D Company, 158th BN. The following are quotes from the last three 1352 reports by the commander:

> 20 September 1975 - "Unit exceeded NORM standard because of the required time to prepare for and the conduct of the Annual General Inspection which included 100 percent inventory and inspection of all tools and equipment. Additionally, the majority of MOS qualified personnel (67N's) in the Service Platoon are recent AIT graduates and therefore lack experience at unit level maintenance".
>
> 20 October 1975 - Same as above.
>
> 20 November 1975 - "Unit exceeded NORM standard because this reporting period was begun with four aircraft undergoing phase inspection. Eight additional aircraft entered phase and a total of seven phase inspections were completed. This unit spent a total of nine days in the field during this period which resulted in a heavier than normal unscheduled maintenance workload. Two aircraft, 68-16576 and 66-0832 were in direct support maintenance for a total of 1259 hours. A total of six days NORM time was lost on aircraft that were test flight status but could not be flown due to weather conditions. The above circumstances were all significant factors that caused the acceptable NORM rate to be exceeded".